DISCOVERY

A MONTHLY POPULAR JOURNAL OF KNOWLEDGE

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WILD BIRD PHOTOGRAPHY.
"Bringing Home the Rations"

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Editorial Notes

For the conventional type of critic, who lugubriously and longwindedly tells us that science and the idea of progress are to be compared to an express train travelling at a hundred miles an hour to a precipice, one has little patience. The Hon. Bertrand Russell has recently published a little book under the title of "Icarus," which comes in rather a different category. He is not the kind of person who would, if possible, destroy every feature which distinguishes this age from the times of Good Queen Anne. He holds that the changes which have been brought about since those days by the discoveries of science have been partly bad and partly good, "but resulted from those discoveries by the operation of ordinary human nature." He is, it appears, a severe critic of human nature—to give him his due, he has never disguised his whole-hearted disapproval of many modern creeds. His text is that you can use a hammer to knock a nail or a skull in, and that humanity prefers, on the whole, to use hammers for argumentative purposes than for carpentry.

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There is more, however, in this little book than mere pessimism. The chapters dealing with organisation in human affairs as it has been advanced by science deserve careful consideration. Our opinions, he says, are to-day formed for us by the newspaper, and organisation has limited greatly the number of newspapers. He evidently believes that there would be only one newspaper (a terrible thought, when one pauses to guess which one it would be) if it were not for the pleasure of competition which prevents, in his own illuminating example, two football teams from combining to kick the ball into the same goal. As it is, however, our opinions, he fears, are formed for us. There is too much truth in this, unfortunately, for our peace of mind. What man to-day can say that he believes, in 1924, all he believed in 1913 or in 1918? It was not so much the newspaper propaganda which swayed our minds; most of us have long ago learned that "if you see it in *The Daily Moon* it is not so." It is the unconscious premiss, the basic principle which is taken for granted, which misleads us. We are not ready enough to start at the beginning. Similarly, a lunatic may appear most alarmingly logical, and in fact may be so; the trouble is that his first premiss, for example, that he is a poached egg, is unjustifiable. The comedies of W. S. Gilbert owe their charm to the logical working out of false premisses. And all wars, all crimes, all foolishnesses which we commit as a community are due to the same process.

* * * * *

The Hon. Bertrand Russell has written a delightfully witty book, reminiscent of Bernard Shaw, with a restraint and a sincerity which Shaw does not always achieve. He fancies a world where citizens are inoculated with gland extracts (or anything else, for he does not commit himself to an unqualified support of modern theories, in which he is very wise), so that they may become, emotionally, what the Government wishes. He could wish to believe that the Poincaré of that day would be injected with kindliness, and go on a crusade of mercy to Ruhr miners. He fears that the State would desire citizens at once domestically subdued, and nationally bellicose, and thinks that the middle-aged doctors who would then be our rulers would inject such essences as would produce these qualities. If only human beings would realise the power of kindliness, he sighs! Kindliness is the only hope for mankind.

* * * * *

"Icarus" was written as a reply to J. B. S. Haldane's remarkable lecture, read before a Cam-

bridge society known as the "Heretics," and published under the title "Dædalus."* If one half of Mr. Haldane's prophecies come true—and most of us will live long enough to verify some of them—we are in for a series of changes which will make a new animal of man. Tissue-culture, or the preservation and reproduction of parts of living bodies in a nutrient medium for long periods of time, is an established research procedure to-day. Mr. Haldane believes that, in the near future (1968 is the half-serious date given), the children of human beings will normally be produced by similar methods. There is nothing theoretically impossible in such a proposition to-day. In practice the growth of even a few dozen cells on a glass microscope slide involves a technique of extreme difficulty, and there is a very low limit to the size to which such cultures can grow. Still, it is possible to watch a heart beating and a nerve growing under the microscope in 1924 !

* * * * *

Much of the lecture is devoted to a discussion of the probable results for humanity of this coming event. But there are other suggestions, equally astonishing, though less convincing. The food supply of the world is largely dependant on the supply of nitrogen. Many micro-organisms, as is well-known, can, in conjunction with plants, "fix" atmospheric nitrogen so that it becomes suitable for assimilation by the human body. A wonderful purple microbe is going to run loose in 1942, get into the sea, "ginger-up" seaweeds to such an extent that the Atlantic sets into a jelly ; the fish will multiply exceedingly, when these seaweeds are dissolved by sea-scavenger microbes, and fish will thrive so much that the world will live on fish. Sugar and starch, developed from the now useless skeleton elements of plants, will be as cheap as sawdust. Perhaps new drugs, harmless in action, will take the place of alcohol and caffeine ; (what will be the attitude of the American Government towards them ?)

* * * * *

These advances are probably only meant to be typical of the kind of way that science is most likely to move. It is all exceedingly plausible. The net result will be, presumably, that we shall all spend most of our time in what are at present our spare time occupations. There will be little need for anyone to work. What on earth are we all going to do ? Is there enough amusement in the world to fill a life-time's play-time ? And will the world war of 1999 be for the possession of St. Andrew's Golf Course ? It is all terribly anxious thinking. What a horrible diet sugar and fish will be !

* * * * *

The recent death in America of Dr. Albert Abrams removes a romantic figure from the rather prosaic ranks of men of medicine. He was the inventor of a mysterious closed box, whose contents none but he knew or could understand. By means of this box, a patient's blood or even handwriting, and a healthy patient, Dr. Abrams was able to diagnose any disease on earth. Although many of his followers were prosecuted in America for fraud, he died worth nearly a million pounds. He appears to have had the most primitive conceptions of matters electrical, but this did not deter him from using all kinds of electrical apparatus for his purposes. He knew nothing, for instance, of the closed circuit ; his writings contain such wonderful remarks as : "The energy discharge from a giant magnet with a lifting power of approximately 400 pounds to the square inch has an energy discharge of only 32 ohms."

There is growing up to-day a numerous class of persons of whom Abrams was a type. Most scientific jargon sounds the same to the inexpert. Particularly is this true of psychological language, and the result is that many trade on the ignorance of the public, and its desire to appear learned, by providing them with long words and queerly assorted consonants—at a price. And the locked box has been an irresistible attraction ever since the days of Pandora, who let all the evils in the world out of it. Our contemporary, the *Scientific American*, made many attempts to investigate Abram's claims, but he always avoided their representative's tests. One of his pupils, however, succeeded in completely mis-diagnosing a series of bacterial cultures offered as a test case. In this country, we think a little unnecessarily, an offer has been made to test Abram's electronic reaction on a number of patients, although at present no official support has been given to the project.

* * * * *

As we announced in our March issue, DISCOVERY enters with this number on a new stage in its history. It will in future be published by Messrs. Benn Bros., Ltd., who are already familiar to most of our readers as the publishers of numerous valuable scientific and artistic books and periodicals. The trustees and committee are maintaining their association with DISCOVERY as before ; an announcement concerning editorial management will be made in due course.

We feel sure that we are expressing the feelings of all our readers in thanking our late publisher,

* "Dædalus, or Science of the Future," by J. B. S. Haldane. Kegan, Paul, 2/6.

Mr. John Murray, for the great services which he has rendered DISCOVERY from the date of its foundation up to the present day. The trustees, the committee, and all who have been associated in an editorial capacity with this journal retain the most cordial memories of his unfailing care and interest; only those who have, from the outset, been entrusted with its direction know how great is their indebtedness to him. In addition, we take this opportunity of thanking our anonymous guarantor, whose intervention at a critical moment rendered invaluable service.

Coral Islands.

By Cyril Crossland, M.A., D.Sc., O.N., F.Z.S.

THE S.Y. "St. George" has recently sailed for a scientific expedition among the tropical islands of the South Pacific, carrying an ethnologist, geologist, and representatives of the main branches of biology, land and marine.

Among the problems to be attacked are those of the coral reefs, some of which are, (1) Comparison of the reefs east and south with those already described in the western Pacific, (2) Examination of the fiord-like bays of certain islands and the isolated peaks which rise in the centres of certain atoll-like lagoons, (3) to seek an explanation for the absence of reefs from many islands which appear to be as well situated for coral growth as any others.

The western archipelagos have already been well described by Lister in the Tonga group, Gardiner in the Fijis, Sollas Gardiner and others in the Ellice islands (Funafuti), with geological supplements in the Fijis by Andrews and Guppy. Though much of the eastern archipelagos have been visited by Agassiz and others, little *detailed* work has been done upon them; though we have valuable summaries of the topography and geology of the more important groups, and though it seems likely that they will conform to the types of islands already described, the comparison cannot fail to be of interest.

The fiord-like bays of some of these eastern islands and the isolated peaks rising in the centres of atoll-like ring-reefs are at first sight obviously marks of the drowning islands of the Darwinian theory of submergence, but on the other hand examination in detail of the islands so far explored discovers evidence of continuous emergence, in operation to the present day. This paradox may find its solution in the fact that all these islands are of volcanic origin, due to eruptions partly beneath and partly above the sea-level. It seems probable that denudation of such a mass may produce results differing widely from that to which we are accustomed in continental stratified and metamorphic rocks.

Problem No. 3 will probably be difficult. The absence of reefs from islands in the vicinity of those surrounded by fringing and barrier reefs, with atolls not far away, might be due to (*a*) cold currents, e.g., welling up from deep water, (*b*) the sheer rise of the islands from great depths providing no substratum upon which coral reef organisms could grow, (*c*) the nature of the substratum offered for the settlement of coral larvæ, (*d*) inability of the larvæ to cross the intervening seas.

Problems and Explanations.

Each of these explanations merely opens another series of questions.

(*a*) Upwellings of cold water may be found, as the unexpected existence of strong currents in deep water has been amply demonstrated among atolls by Gardiner. Should such a current strike a steep submarine bank it might be deflected to the surface and so form a local chill, perhaps perennial, perhaps periodic, which would prevent the growth of reef organisms except in a few sheltered situations. Should such an emergence of cold water be only periodic the chances are that it may not be proved for years to come, though such a movement, occurring only once in several years, would suffice to prevent the formation of reefs.

(*b*) This suggestion is due to Agassiz, but is difficult to understand as a possible result of the piling up of volcanic material or the formation of great sea cliffs by marine denudation. It seems to demand rather an enormous fault movement, the tearing up of a part of the sea-bed into a cliff of extraordinary abruptness. This, though very unusual, is not an altogether impossible explanation.

(*c*) The only substratum upon which coral larvæ could not settle would be one kept in motion by waves or exposed to the rasp of shifting sand, and it seems impossible that a mound of volcanic material could be reduced to a shoal 30 fathoms below sea-level without large areas being washed clear of mud and sand, particularly round its edges. Also the elevated "soapstone" of Fiji and elsewhere shows that coral reefs can be formed upon a layer of fine volcanic sand (probably through the intermediacy of scattered molluscan shells) and in the Red Sea coral is found practically directly overlying gypsum. In short, though a very little rasping through moving sand will prevent coral growth, corals seem to care nothing otherwise for the nature of the substratum.

(*d*) It is stated that the number of species of corals (and other fixed animals), which is at its maximum at the Great Barrier Reef of Australia, decreases continuously as one travels eastwards. This is what one would expect, the floating larvæ being limited in their ability to cross the seas from one group of islands to another, particularly as the *main* ocean currents north and south of the equator are against their dispersal in this direction.

There seems no reason why three or four species of coral, in conjunction with stony seaweeds and

FIG. 1.—FLORA. d. CORAL RAG BUSH.
e. STRAND FLORA, INCLUDING (é) CASUARINA

ROCKS. a.a. DEEPLY UNDERCUT CORAL CLIFFS.
b.b. ROCK FLAT (AT HIGH TIDE).
c.c. BEACH WITH VILLAGE, ETC.

foraminifera should not form as good a reef as the hundred or so which usually co-operate in the building. Perhaps the absence of some minor constituent may restrict reef formation.

This problem of distribution of species will be attacked indirectly. Corals are so influenced by their immediate environment that their systematic arrangement is exceptionally difficult, almost as impossible as would be the case in botany if angiosperm plants produced no flowers. The general effects of the currents upon floating larvæ can be gauged by a series of collections of those actually afloat at the time of our voyage, but especially by those of adult organisms such as hydroids, and other zoophytes, alcyonaria (gorgonians), worms, etc., which have owed their distribution to the same means.

In view of the expedition a description of the scenery of coral reefs may be of interest.

The Romantic Stage.

As a stage for romance the coral islands and their blue lagoons still hold their own in spite of the recent irruption into fiction of strange beings from the nearer east termed "Sheiks."

To the man of science, a creature whom "no fellow can understand" in any case, it is the mere stage, the coral island which is more romantic, and even more dramatic than the play. Though he does not personify the giant forces of volcanic eruptions or those vast life forces so hidden from mankind which set boundaries to the ever-beating, thunderous surf, yet their interaction makes a play beside which the individual loves and hates of white men and brown are small and incidental things. To the romantic also an accurate description of the stage details may be of interest.

The Reef.

Let us imagine ourselves setting out from a native village to explore the reef fringing a large island or a continental shore.*

The village is hidden in a grove of coco-palms, the huts both walled and roofed with their plaited leaves. Indeed, in a purely coral islet the palm is everything to the inhabitants, providing meat, drink and shelter for themselves, and fodder for their pigs and fowls.

Coral is everything else! If there are one or two stone houses they are built of coral and white-washed with coral lime; the soil is the remains of coral, may be a mere drift of sand (broken coral, foraminifera shells and stony seaweeds, every item a sea-growth) washed up against the base of a low cliff which runs from the shore inland to the back of the village, and by its undermining by the waves show that it was once the boundary of an open bay. Beyond this cliff the coral rock appears at the surface as a level of hard, black clinkers, of an extraordinarily ragged appearance, covered with sharp points and ridges, full of holes, as unlike coral or other limestone as it could well be. In tropical East Africa this is covered

* In the main this description applies to the east coast of Zanzibar, with notes where conditions there are unusual.

with the monotonous bush, which results from periodic burning in order to make clearings in which sweet potatoes, "muhôgo" and dûra corn may be cultivated in these holes which contain a spadeful of soil.

In more fortunate localities this "coral rag" has been further broken down by the rain (or it was originally less resistant) into a reddish soil, forming an oasis of the beautiful vegetation we associate with the tropics, bananas and jack-fruit, with their great leaves, mangoes and oranges, and even perhaps that rarity in most tropical countries, outside European gardens, a show of flowers. The untouched forest, with its great trees bearing orchids and ferns all tangled in creepers, remains only as relics covering the village burial-grounds.

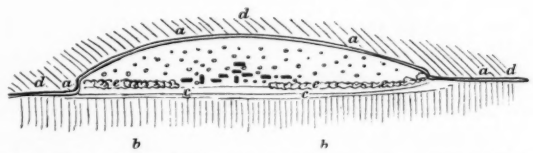


FIG 2.—PLAN OF THE SAND DRIFT SKETCHED IN FIG. 1 SHEWING CONTINUATION OF SEA CLIFF BEHIND VILLAGE AND COCOANUT GROVE, ALSO CONTINUITY OF CORAL RAG LAND WITH REEF FLAT ROCK LETTERS AS BEFORE.

Coral Island Flowers.

Our errand, however, is seawards; on our way to the beach we pass from the open ground beneath the palms into a belt of shrubs which lines high-water mark, laurel-like bushes with a small scented flower, the weird pandanus ("screw-pine" is the European name, as inappropriate as usual), and aromatic herbs underfoot, perhaps some of that fine feathery branched conifer, the casuarina towers above these shrubs and rivals or exceeds in height the palms behind. The last of the land plants is the creeping convolvulus, *Ipomaea pes-caprae*, forming a dense carpet of brilliant green, with large red flowers in the early part of the day trailing over the sand until its stems are killed by the highest tides. Plants which will grow in coarse limestone sand with no other mineral, close to and hardly above the level of the sea, are naturally a highly specialised group, and as would be expected its members are widely distributed not only universally throughout the Indian Ocean but with many members extending into the Pacific. (This convolvulus has been a boon to Port Sudan, in the Red Sea, where the search for plants which would relieve the universal yellow rock* with a touch of green and flourish in the brackish water of the desert wells was a matter of great interest to the first inhabitants. Its seeds were procured from Mauritius). Emerging on to the open beach one generally finds that it soon ends on either hand in low black cliffs, perhaps 10 or 15 feet high, strangely overhanging. In sheltered places this overhang may extend six feet or more horizontally without falling from the cliff, and be cut into the strangest shapes, but where the waves break with violence, though the undermining is conspicuous, the overhang breaks off before it has attained such phenomenal dimensions.

In this way the reduction of the cliffs by the sea is conspicuously demonstrated, but the evidence of the same to which we are accustomed in home waters is equally conspicuously absent. Instead of a shore littered with boulders and piles of them against the cliff, the shore platform is of level rock continuous with that of the cliff, and throughout East Africa and the Red Sea not a loose stone upon it. Though this bare smoothness is not so extreme in many other reefs it is everywhere a characteristic contrast between coral and other shores.

The Hidden Life of Coral Reefs.

Indeed, the first sight of a coral reef is a painful disappointment to the enthusiast who has read of coral gardens and gloated over Savile Kent's photographs. From the beach the reef at low tide is the image of desolation, a mere expanse of smooth rock covered with a greyish film of sand or mud. The boulders which diversify a temperate shore, support vigorous growths of golden and brown seaweed and shelter all manner of living things, present an infinitely richer spectacle. This comparative absence of weed, except the stony lithothamnia in places, is one of the striking differences from home shores. Suppressing our disappointment let us persevere in our exploration. Under the few stones we meet, or slabs which can be raised by a crowbar, we have the satisfaction of seeing something of tropic colour. Gorgeously coloured sponges and ascidians abound out of sight, painting the undersides of stones with vivid patches of red and yellow, blue and black, more rarely pure white, and we note that worms are more frequently Erinicidae than Nereidae, and in place of big worms we may dig up (if we are prepared to break into solid rock) Sipunculids and Echiuroids. Further out we shall probably have to wade a pool of more or less cloudy water, a long pool which at low tide stretches like a sluggish stream between the beach platform and reef edge. Here we shall certainly find numbers of great black Holothurians, perhaps brilliantly coloured Synaptas an inch thick and three or four feet long, both forms of life which, if ever seen at home, are found only as miniature representatives of the family.

* Owing to lack of rain the coral limestone is yellow, not black, in the Red Sea.

We may meet with a coral or two, usually the poorest substitute for the coral gardens we had hoped for. The abundance of marine phanerogams, grass-shaped flowering plants which become adapted to submarine life, are often many times as conspicuous and abundant as are the true seaweeds.

The raised outer edge of the reef, upon which great waves are breaking, is of level rock, upon the inner part of which we can walk at low spring tides. Here

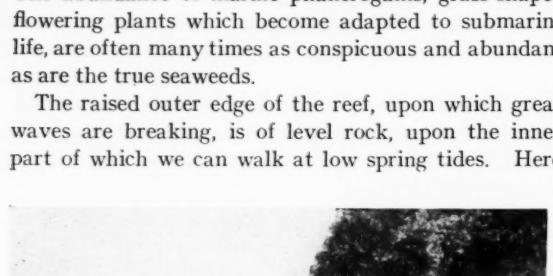


FIG. 3.—UNDERCUT CLIFF IN CHUAKA BAY, ZANZIBAR; NOTE THAT THE FALLEN MASS IS RESTING ON THE SOLID SURFACE OF THE REEF FLAT AND IS ITSELF BEGINNING TO BE UNDERCUT.
(Author's photo in "*Desert and Water Gardens of the Red Sea*," by permission of the Syndics of Camb. University Press).

perhaps are more corals,* but of stunted growth, as is obviously necessary in such a turmoil of waves. Most of the surface is made of broken coral branches cemented together by stony seaweeds, which cover the whole surface, in some cases the whole bank is a mass of stony seaweeds with corals and their remains practically absent. Generally the seaweed slope is fissured and buttressed, that is, long trenches run in from the sea, up which the breakers pour masses of water while the tops of buttresses are revealed by the retreat of a wave, standing a little way out from the edge.† These will later become fused into the edge as it extends seawards and fresh buttresses arise outside them as the water shoals to provide their foundations.

Here is vigorous life enough, though the lithothamnia have little variety, appearing only as nodules, bosses and incrustations of dull red colour, sometimes orange or white. Corals occur on the sides of the fissures, often in considerable variety, but on the whole the life of this area, the actual growing part of the reef, can only be glimpsed between the rollers. The examination of the slope beyond the breakers is naturally a matter of piecing together evidence obtained fragment by fragment with difficulty and some danger. Under lucky conditions of weather something can be seen of the upper part of the slope, below that indications may be obtained by the sounding lead, by dredges and tangles. Sounding is *comparatively* simple, but the lead may strike the bottom and then fall fathoms further, indicating buttresses and trenches like those seen from the reef edge. Dredging is obviously impossible, the most that can be done is to snatch a sample here and there until evidence has accumulated which can with patience be pieced together. Even in the deep water into which the first slope drops almost precipitously, dredging with every precaution is almost equally difficult. For instance, when Gardiner left Colombo in H.M.S. "Sealark" for the exploration of the reefs and banks of the Indian Ocean he had on board 19 dredges of which, despite the constant efforts of the blacksmith, only 7 were serviceable on arrival at Mauritius. The whole of the great slope outside coral atolls is of rock, often fairly smooth, comparatively barren of life, but with irregularities which provide the almost immovable object met by the nearly

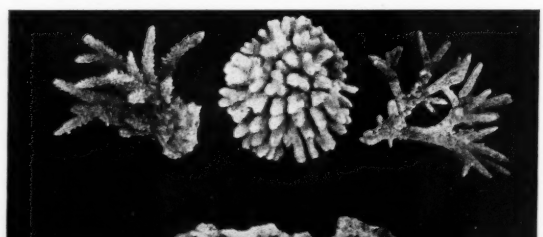


FIG. 4.—CORALS.
ABOVE: THREE FORMS OF ACROPORA.
BELOW: COCLORIA, PORITES, FAVIA.
The Porites having grown to the surface is dead and flattened on top, alive and growing outwards at the sides. (From "*Desert and Water Gardens of the Red Sea*," by permission of the Syndics of Camb. University Press).

irresistible force of the ship with inevitable disaster for the dredge. However, in no other way could direct evidence of the nature of the bottom be obtained.

Coral Gardens.

Accessible coral gardens are to be found in plenty in favourable places. On the dead reefs of the east

* Not in Zanzibar and tropical East Africa, where the whole reef is cut out from elevated coral, and owes none of its breadth to recent growth.

† Features not seen in the growing reefs of the Red Sea.

coast of Zanzibar the muddy channel became clear at certain points where it opened into the sea through the reef edge. At these points coral and other growths were filling up a part of the channel, blocks composed of a number of coral species growing to the surface, where of course the corals die and form a level rock flat, which was covered over by red stony seaweed, thus renewing the rock surface the solution of which had originally formed the channel. At another, almost the sole coral was of the genus *Porites*, which formed great cylinders, six to twelve feet across and as many deep, the tops of course cut off level with that of the water at low spring tides; so close together were these that one could cross the channel by stepping from one to another, looking down into a fathom or two of clear greenish water over their sides, clothed with the living yellow brown polyps.

In the Red Sea the outer slope ot the reef is a simple bank, covered with growing corals to a quite exceptional extent. Given fine weather and an off-shore wind, one may drift for miles in a row-boat delighting in the beauty and astonishing variety of corals, with occasional millepores, antipatharia, alcyonaria, sponges and all the hosts of fish of every size and shape and colour which inhabit their crevices and grottos.

Arbitration in Wage Disputes.

By Henry Clay, M.A.,

Jevons Professor of Political Economy in the University of Manchester.

I.

THE revival of interest in wage disputes, that the recent strikes have excited, has led, as such revivals after an interval of peace often do, to a demand for compulsory arbitration. A comparison is drawn between industrial disputes and disputes in commerce and other fields of social relations. Why, it is argued, should the community be put to the inconvenience and suffering caused by an interruption of railway services or a "blockade" of a port, merely because a section of employers and employed have failed to settle their differences? Other differences, which might inconvenience the public it settled by force, are settled in a Court of Law. Cannot a similar procedure be imposed on industry, to supersede the present "lawless," anti-social trial of endurance?

The analogy is attractive, but fallacious. For what are the essentials of the process of judicial settlement of disputes? Simply the application of an agreed or accepted rule or principle to a particular case. The Court elucidates the facts; the rule is contained in the Statute or Common Law which both parties may be presumed to accept; the judge declares the law, and the verdict follows it. But what accepted principles have we to apply to a wage dispute? How, if not by a trial of strength, was society to decide whether the docker's rate should be twelve shillings or ten shillings a day? We use phrases, such as "a fair day's wage for a fair day's work," but what exactly is the measure of "fairness," and what is a fair wage in pounds, shillings and pence? The docker's rate yields an income quite inadequate judged by the standards of middle-class expenditure; but it is two and a half times as great as the agricultural labourer's rate in many counties; and even a Labour Government would not think of imposing on agriculture to-day a minimum wage of twelve shillings a day. Our judge, if we compelled the parties to wage disputes to submit their differences to a Court, would have no law to declare; there is no law, because society is not sufficiently agreed on any ethical or social principles by which rates of remuneration can be determined authoritatively.

The analogy is fallacious also because it does not distinguish between differences which the law does require the parties to take to Court, and differences which it does not. A difference over the interpretation or performance of a contract can be settled by the Court, because there is a body of Contract Law; but it is only in rare and exceptional cases that the Court can determine whether a price in a contract is fair or adequate. Yet it is differences over prices with which we ought to compare disputes over wages. When retail prices reached their peak in 1920, the ordinary customers of the shops restricted their purchases; this action was so general that it was called a "buyers' strike," and that was precisely what it was; yet no one suggested compulsory arbitration in that case. A wage is a price, differing from other prices only in the more important social consequences that depend upon it. A community that sought to settle wages by authority would find itself driven on to fix the prices of all important commodities.

The Conflict of Interests.

Let us press a little further our analysis of the conflict of interests, which issues in strikes and lock-outs.

The question of wages is not the only aspect; the subordination of the wage-earner in modern industry to the direction of the management involves frequent conflicts that have nothing or little to do with wages; but the wage aspect is much the most important

aspect, as is shown by the large proportion of disputes that turn on wages.

Immediately, wages are a question between employer and employed; or, in modern industry, between employers' associations and trade unions. But the employer is not a free agent. Ultimately, the wages he can pay and the employment he can give are limited by the price he can get from his customers, and the amount of his product he can sell. In other words, wages are a question between worker and consumer, with employer as a sort of middleman between them. Hence the private employer can be eliminated without eliminating the possibility of strikes. One of the most important strikes of last year was a strike in the Co-operative Movement, which is owned and managed directly by the consumers of its products and services. Similarly strikes occur in municipal employment, where the private employer has been superseded by the Local Public Authority. The recent strikes are illuminating from this point of view, since the Railway Companies have a statutory right to rates that will yield their pre-war profit, so that they can transmit any additional labour charges on to the railway users; while the dock undertakings are almost all managed by representatives, and in the interests, of dock users and Local Authorities.

Even if State and co-operative employment were swept away, and industries managed by self-governing guilds or syndicates of workers, the conflict of interests that issues in the strike would still persist. The only change would be in form; the discussion would turn, not on the "wage" to be paid, but on the "price" to be paid, for the services of certain classes of workers—a distinction without a difference. How would the terms, under such a system, be settled, on which dockers should handle agricultural produce, or locomotive enginemen take over traffic from dockers?

The Principle of Specialisation.

The truth is that the conflict of interests over wages arises from the most elementary and fundamental characteristic of the present technical organisation of wealth production, the principle of specialisation, which involves the splitting-up of the process of making the simplest article among thousands of different individuals, and the wide separation, both in space and time, of producers and consumers. Unless therefore a society can agree on some guiding ethical or social principles, so precise and definite that they can be translated into legislation and applied in administration, by which the remuneration of different classes of work can be determined, the necessary basis of an authoritarian regulation is lacking, and wages (like prices) will continue to be settled by bargaining. The forms of the bargains and the organisation of the parties may change. At present the bargaining between producer and consumer takes place through the employer working for profits. He acts as a shock-absorber; eliminate him, and the conflict of interest becomes obvious; the management, which takes his place, will tend to be a shock-transmitter.

Some such theory of industrial relations as I have outlined underlies the policy both of successive Governments and of organised labour and capital in this country. The most recent official inquiry into the problem was made by the committee of the Reconstruction Committee, over which Mr. Whitley, the Speaker, presided. The Committee consisted mainly of experienced officials of employers' associations and trade unions; unanimously they rejected the proposal of compulsory arbitration. It may be inferred that the wage-earner feels that he must, in the last resort, retain the right, collectively, to withhold his labour; equally employers, though perhaps with less unanimity, feel that they must be able to insist, by stopping the industry, on the terms of employment they consider necessary. Similarly, the State in this country in modern times, except in the abnormal conditions of war, has always refused to fix rates of wages, either by Parliamentary legislation or Administrative Order. Parliament, and its instrument the Board of Trade, has encouraged collective bargaining, supplemented it by offering the services of its conciliators or of arbitrators under the Conciliation and Arbitration Act of 1896. This provision it has extended and supplemented since 1920 by the establishment of an Arbitration Court of high authority in the Industrial Court. By the same Act it has taken power to set up Courts of Enquiry, with power to call for all relevant evidence and report on disputes. It has even insisted on collective bargaining, by the establishment of Trade Boards, representative of the employers and workers in trades in which "no adequate machinery exists for the effective regulation of wages," and giving the force of law to the determinations of these Boards. But it has avoided the actual fixing of wages by its own act. And it is unable to take any other course, until there are generally accepted principles of justice in remuneration, on which legislation can be based.

II.—TRADE BOARDS.

So far we have considered only the possibility that the State might seek to compel the settlement of wage disputes by a judicial procedure parallel with

that by which it secures the peaceful settlement of disputes about property or contracts. The precedent of Trade Boards suggests another, less revolutionary, method of intervention.

In the case of Trade Boards the State enforces rates, which it does not itself fix and for which it takes no direct responsibility. Could it not in the same way enforce rates fixed by independent arbitrators, giving them the same freedom from administrative interference as it gives judges and taking as little responsibility for their decisions ?

The war period provided an experiment in compulsory arbitration on this method. Strikes on munitions work were made illegal by the Munitions of War Acts, differences had to be referred to arbitration, and the arbitrators' findings were legally binding ; and the arbitrators were, at any rate nominally, free from any official guidance, and their functions were restricted to serving as a substitute for the strike or lock-out as a last resort. The conditions were favourable to such an experiment. Employers and workmen on the whole were anxious only to assist the prosecution of the war and were therefore predisposed to forego the strike weapon ; at the same time the period was one of rapid economic change, affording abundant opportunity to test the tribunal's authority. Finally, the prohibition of strikes and lock-outs did not extend to the whole of industry ; it was confined to munitions production and incidental services, so that it is possible to compare the results of compulsory arbitration in these industries with the normal "right to strike" in industry in general.

The comparison is made in the following table, taken from the official history of the Ministry of Munitions.

INDUSTRIAL DISPUTES KNOWN TO BOARD OF TRADE.

		Disputes.	
		All Trades.	Metal (Munitions) Industries
1911	Average of four Quarters	226	64
1912	" " " "	214	58
1913	" " " "	374	98
1914	First Quarter	247	66
"	Second "	416	91
"	Third "	195	47
"	Fourth "	141	39
1915	First "	161	54
"	Second "	199	47
"	Third "	171	43
"	Fourth "	143	33
1916	First "	130	36
"	Second "	170	21
"	Third "	114	23
"	Fourth "	111	24
1917	First "	80	18
"	Second "	130	33
"	Third "	238	56
"	Fourth "	240	74

The comparison suggests that the legal prohibition of strikes had no effect at all. Strikes were just as frequent in "controlled" industries as in uncontrolled. Probably the table understates the full effects of prohibition ; strikes might have been more numerous in the difficult conditions of munitions production but for the prohibition ; but it is sufficient to indicate the inefficacy of mere legal prohibition, even under favourable conditions, to prevent strikes. Administratively, also, the war experience proved the impracticability of enforcing a regulation of this sort against the will of large masses of workpeople.

Experience in Australia.

The experience of the Australasian dominions may be cited to the opposite effect. There compulsory arbitration on one system or another is general, and the former judge of the Federal Court has claimed that the work of the arbitration tribunals constitutes "a new province for law and order." It should be noticed that Australasian experience is not necessarily relevant to English problems. The dominions are immensely rich ; they carry out their experiments in social legislation within the shelter of high tariff walls ; the numbers affected by any decision are small by English standards ; their manufactures are not carried on, to the extent British manufactures are, for export. But disregarding these differences of circumstance, and considering only the point of principle, we cannot say that the Australian experience is decisive.

The statutes constituting the various Courts differ, some laying down in general terms that the Courts shall grant a "living wage," others leaving the Courts unfettered. In the former case, the difficulty we have apprehended, the difficulty of defining in precise terms a living wage, has arisen. There has been wide difference of opinion, and in practice the decision has been guided obviously by contemporary Australian standards—in just the same way as our own Trade Boards, without any statutory obligation to fix wages on any principle, have been guided by the actual wages paid (as a result of bargaining) in allied and related occupations. With this general limitation, the Courts have been able to introduce some degree of "law and order" into the conditions of employment, by regularising the form and conditions of the wage contract, and imposing uniform decisions in like cases. But even this restricted element of principle has not been applied without difficulty. So far as the arbitrator introduces new principles into the wage-contract, he is legislating ; since he is a Govern-

ment servant, even if he does enjoy judicial independence, the Government cannot wholly escape responsibility for this legislation; cases have inevitably arisen in which Government and Court disagreed in principle, with the result that the Government has been unwilling to lend its coercive powers to uphold the authority of the Courts.

The Australian experiment, in its special conditions, has had some success in limiting the number of strikes, and the ability of its judges has contributed not a little to the elucidation of wage problems; but such success as it has had must be attributed, in part, to the special conditions of Australian industry, and has been proportionate to the closeness with which the decisions of the Courts have kept to the ordinary results of collective bargaining.

III.—VOLUNTARY ARBITRATION.

The Whitley Committee, while rejecting compulsory arbitration, recommended the practice of voluntary submission of disputes to arbitration. In this, as in its other recommendations, the Committee summed up the lessons of English experience.

For voluntary arbitration there is a great field. *Voluntary* submission is essential, because an award cannot be enforced against the determination of perhaps half-a-million workpeople, and the stability of a settlement depends on the sense of loyalty to it felt by the parties. Subject to this condition, experience points to three categories of cases in which arbitration is effective.

The first is the case of differences in an industry, in which relations between employers are good, both sides are well organised and the organisations of the two sides have a long tradition of collective bargaining. Given these conditions, conciliation will often narrow down a difference to such limits, that the parties to the dispute will be prepared to accept an outsider's arbitrament, rather than incur the losses of a stoppage. The duty of an arbitrator in such a case is, it seems to me, to endeavour merely to gauge the strength of the two parties in conflict and to give as his decision the result which in his opinion a strike or lock-out would have given. The chances of resort to, and success in, voluntary arbitration of this sort is very much enhanced, if there is available a person like Lord Askwith, trusted as impartial, whom the parties can call in and whose decision will command confidence.

A second category is the employment of an arbitrator to interpret the terms of an agreement or award, which in principle is already accepted. The greatest care will not ensure that in all cases an agreement will cover all the questions that arise under it. Since no question of principle is involved in a difference of this nature, the services of an interpreter of the agreement can be accepted without fear of causing serious dissatisfaction; if his interpretation is that the agreement bears a meaning different from that which was intended when it was made, there is a case for revising the agreement by the same procedure as was used when it was originally made.

"Single Point" Differences.

The third category is intermediate in importance between the other two. It often happens that a difference can be narrowed down to a single point, the amount of adjustment needed under a specific head, the need of some adjustment being conceded. Specific adjustments of this sort can often be made best by a third party. Thus, during the war, when there was a general understanding that no one ought to make exceptional gains out of the war, wage disputes could be narrowed down to the question of making adjustments to changes in the cost of living, which the Committee on Production in the latter part of the war was doing very satisfactorily. Under more normal conditions, in the boot and shoe industry, the general standard of wages and conditions are settled by negotiation; but the precise allowance to be made in the very complicated piece-lists of the industry for a slight technical modification in a job is remitted to an arbitrator with technical knowledge.

There is a field, then, a wide and important field, for arbitration in the settlement of wage disputes. Arbitration does not, however, offer a panacea for strikes and lock-outs. These stoppages are only the overt expression of an antagonism in industry that arises from the very nature of industry, from the fact that all production is based on exchange through the market between specialised producers. Looked at in this way, the occasional stoppages of labour are remarkable not for their number but for their rarity. When we consider the complexity and importance of the problems involved in settling the wages and other terms of employment of the sixteen million wage-earners in this country, it is a matter for surprise that a compromise is reached and maintained with so few stoppages. In a bad pre-war year, 1913, strikes and lock-outs involved an aggregate loss of working time less than the equivalent of a single extra bank-holiday; in the worst post-war year, 1921, the loss of time involved was not a third of the time lost last year through unemployment.

The Present Status of the Evolutionary Hypothesis—I.

By Lancelot T. Hogben, M.A. (Cantab.), D.Sc. (Lond.)

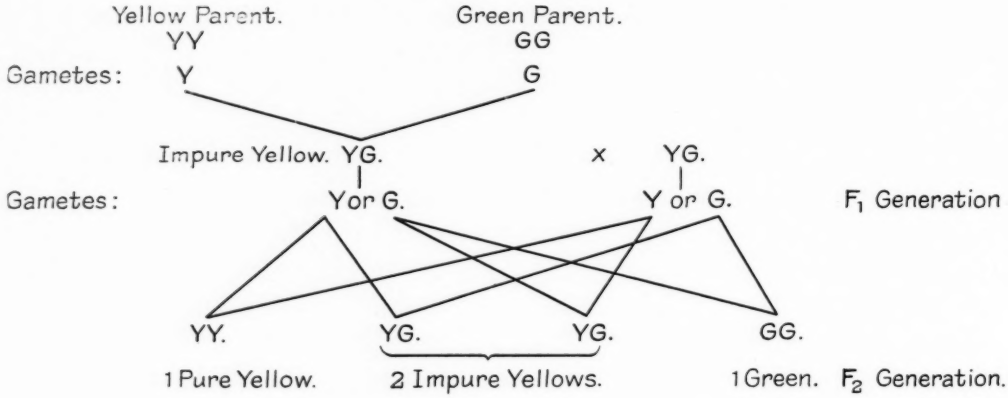
It is customary to regard the Evolutionary Hypothesis as one of those great generalisations, like the Conservation of Energy or the Kinetic Theory of Gases, established by the scientific inquiries of the nineteenth century. The doctrine of descent attained its present status in a whirlpool of embittered controversy. The right of free inquiry in biological science was finally vindicated and in consequence the evolutionary hypothesis gained immensely in prestige. Now that religious opposition has become a negligible consideration, it is possible for the twentieth-century biologist to detach himself more readily from the atmosphere of propaganda and consider how far the assumptions inherent in the evolutionary doctrine are sustained by accredited experimental evidence, and whether there may not still be fields of investigation to be traversed before evolution can be rightly placed in the same hierarchy of scientific generalisations as the atomic theory.

Broadly speaking there are two categories of biological inquiry. Living beings differ from the objects classified as inanimate nature, and one subject of biological interest is the relation of the properties of living and non-living matter. Living creatures also display true-breeding ("genetic") differences among themselves, and the origin of these differences is the special concern of the evolutionary hypothesis. So long as men believed that barnacles might turn into geese the evolutionary problem could not arise as an intelligible issue. From the laborious researches of Linnæus and his contemporaries, which established the fixity of species or fundamental genetic discontinuity of living organisms, the modern evolutionary problem came into being. The generation of Linnæus emphasised the *discontinuity* of living organisms. The generation of Cuvier emphasised the subtle similarities of anatomical structure superimposed in infinite gradation upon this fundamental discontinuity. The generation that followed Cuvier sought to relate these fine degrees of similarity and dissimilarity in organisms to their past history and their present distribution on the earth's surface. From these researches emerged the *Law of Succession*—formulated by Wallace (1854), that every species has come into being coincidently in place and time with the existence of some pre-existing closely allied form. The *Law of Succession* revealed by the study of geographical distribution and the record of the rocks gave us the evolutionary problem in its modern form. It was the writings of Charles Darwin which developed this theme. But the Law of Succession is not the Theory of Evolution. The theory of evolution is a particular interpretation placed on the historic panorama of animal and plant life, namely, that the gradual differentiation of new organic types has been brought about through the agency of the process of reproduction. Clearly then the present status of the evolution theory must be judged in the light of our knowledge of the reproductive process and the adequacy of this knowledge to account for the appearance of new organic types in the past and the fundamental genetic discontinuity of animals and plants as it exists to-day.

Exact knowledge of the hereditary mechanism begins in the opening years of this century with the application by Tschermak, Correns, De Vries and Bateson of a method devised by one of Darwin's contemporaries, the obscure Abbé Mendel of Brunn. Experiments in crossing different races of plants and animals had been carried out long before Darwin's time, and are recorded in "Variations of Animals and Plants under Domestication." Such experiments date from the work of horticulturists in the middle of the seventeenth century. Conspicuous success did not crown these early efforts. This was partly because the relation of parent to offspring was imperfectly realised, for it must be remembered that so fundamental a fact as the origin of a single individual from the union of a single ovum and a single sperm was not directly verified till fifteen years after the "Origin of Species" appeared. It was also partly because these pioneers in hybridisation tended to take the individual as a whole for their experimental unit. It is the essence of the Mendelian method that it deals with pure-breeding stocks differing only in well-defined particulars, employing single characteristics as units of study, and recording the progeny of every cross separately for comparative observation. In his original work Mendel chiefly employed the common pea, which possesses two advantages which recommend it for such experimentation, namely, that its flowers are capable of self fertilisation (i.e., the pistil can be pollinated from the stamens of the same flower), and that it has a number of well-marked varieties, distinguished by tangible characteristics such as the shape (round or wrinkled) and colour (green or yellow) of the seeds, or the stature (tall or dwarf) of the shoot, etc.

The Principles of Mendelism.

As a type of Mendelian experiment we shall consider the results of crossing a variety of pea having yellow seed from a stock breeding true to this feature with an individual from another variety characterised by green seeds and also of pure pedigree. Pollen from flowers of the one is transferred to the stigma of the other, or vice versa; and one result always occurs; every seed produced in consequence of such a union will be yellow whichever way the cross is made. If now these seeds are allowed to germinate and grow into plants, the results of self-fertilising the flowers of the first generation (technically the F1 or first filial generation of the cross), or, alternatively, crossing them with similar F1 yellows, is entirely different from the effect of crossing two of the parental pedigree yellows; instead of obtaining only yellows true to type, it is found that three-quarters of the seed produced (F2 generation) are yellow like their F1 parents, but one-quarter are green like one of the original parents. Further breeding shows that two-thirds of the F2 yellows breed in the same way, throwing greens in the same ratio; but that the remainder breed true to type like the original yellow parent when self-fertilised, as do the greens of the F2 generation, which, when self-fertilised, or crossed *inter se*, have only green offspring.



In seeking an interpretation of these phenomena we must recognise that the hereditary constitution of the yellow individual in the F1 generation differs from the parental yellow since it is capable of giving rise to green offspring; it differs presumably in producing gametes (i.e., ovules and pollen in the case of the plant or sperm and ovum in the animal) characterised by the possession of some material, let us call it without discussing its nature, a "*factor*" or "*gene*," responsible for the production of green colour. Observe now that in the F2 generation the proportions of pure yellow and pure green are identical, that is to say, one-quarter have the gene for yellow only and one-quarter the gene for green only, so that neither of the gametes from which an individual of either type originates contains the alternate gene. Now if, bearing in mind that the F1 yellows behave in a similar manner whether the gene for green is borne by the maternal or paternal gametes (ovules or pollen grains), we postulate that the F1 yellow produces in equal quantities gametes bearing the yellow and green genes respectively—but *never both*—and further that there is an equal chance of any pollen grain fertilising an ovule with the same or an alternative gene to that which it bears, it follows that the number of individuals produced in the F2 generation containing both genes for yellow and green will be twice the number containing only the yellow or only the green gene. For Y may fertilise Y or G, giving YY or GY; and G may fertilise G or Y, giving GG or GY. This, of course, satisfies the conditions and is a satisfactory account of the facts so far. It constitutes the factorial hypothesis of Mendel, that characters distinguishing different hereditary strains depend upon factors or *genes* which are inherited from both parents and segregate in the formation of the gametes, so that one-half contain the paternal and one-half the maternal factor.

Our assumptions may not involve every conceivable possibility, and the value of the factorial hypothesis must stand or fall like all other hypotheses with its capacity to yield verifiable consequences. Inferences of a verifiable nature which can at once be subjected to test are illustrated by crossing back the F1 impure yellows with (*a*) the pure parent yellows, and (*b*) the

greens—which are all pure. Using as before letters to denote the material factors at work, the pure breeding yellows and greens have the constitution YY, GG, on the hypothesis outlined, since their character depends on factors inherited from both parents; the impure yellows F1 have the constitution YG or GY. If our hypothesis is correct, by crossing YG with YY we get two types of offspring YY and YG, equal numbers of pure and impure yellows. Also by crossing YG with GG we get two types of offspring YG and GG, equal numbers of impure yellows and pure greens. Mendel tested these and other implications; and all subsequent inquiry has confirmed the anticipations raised.

We are thus led to regard inherited characters as dependent upon genes derived from both parents, maintaining their separate entities throughout the entire life-cycle and finally separating in the formation of the gametes so that in respect to any single pair of genes one half the gametes contain the gene derived from one parent and the other half contain the gene contributed by the alternate parent. An individual which receives like the "impure" F1 yellow different factors from its parents is said to be *heterozygous* in contradistinction to the *homozygous* (greens and pure yellows) type.

The Law of Segregation.

We have now stated in general terms Mendel's fundamental law of segregation. Two factors which segregate with respect to one another constitute an *allelomorphic* pair. When the presence of one allelomorph suppresses the visible manifestation of the presence of its partner in a heterozygote, the character which predominates is said to be *dominant*, and the character which fails to appear in the heterozygote *recessive*. But dominance is not universal. For instance, if we cross individuals from pure stocks of the red and white varieties of the flowering plant known as four o'clock or botanically as *Mirabilis jalapa*, the F1 generation bear exclusively pink flowers. If these F1 heterozygotes are selfed or crossed *inter se*, the F2 generation is composed of reds, pinks, and whites, in the proportion 1 : 2 : 1. This would correspond to the 3 : 1 ratio if the heterozygotes were similar to one or other type of homozygote. In the case of the Andalusian fowl, the F1 individual produced by crossing black and splashed white birds is blue. Consequently the mating of Blue Andalusian fowls always throws blacks and whites. Hence, if we wish to obtain blue individuals it is more profitable to mate blacks with whites, giving a heterozygous generation of blues only; for the effect of crossing the blue heterozygotes among themselves is to raise a progeny of blacks, blues and whites in the ratio of 1 : 2 : 1. In these cases the heterozygote is intermediate between the parental homozygous types. In the case of the inheritance of the white colour of Leghorn fowls, we have an instance of what may be called incomplete dominance; for, if mated with an individual of a coloured strain, the heterozygous individuals are white with a few coloured tail feathers. Whatever be the degree of resemblance between the F1 generation of a cross between pure stocks and the parental types, the factors remain distinct and recombine to produce the original parent types again in the F2 generation.

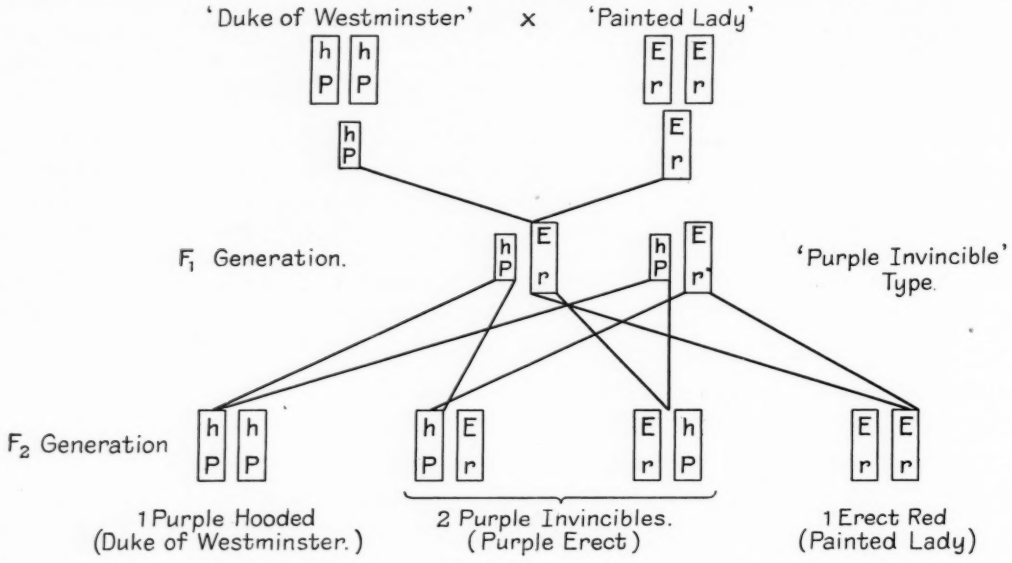
It must not be imagined that a definite character distinguishing two related forms need only depend on one pair of genes. Mendel was particularly fortunate in hitting upon a form in which there exist a number of strains which differ with respect to single pairs of unit factors. Had he studied, for example, the inheritance of the "walnut" type of comb which occurs in the Malay breeds of domestic fowl, he would have had a more difficult problem. The "rose" comb of Wyandottes and the "pea" comb of the Brahma breed are each dominant to the single comb of the Leghorns, Sussex, and Rhode Island breeds. The "walnut" can be produced by crossing individuals with the rose and pea types of comb. An individual with a walnut comb crossed with an individual from a single comb breed would give an F2 with walnut, rose, pea and single combs all represented, because the walnut type differs from the single comb in respect of two pairs of factors, namely, those responsible when present alone for the pea and rose types.

In the crosses which have been previously discussed, character differences in which only one pair of allelomorphs is involved have been deliberately selected for the sake of simplicity. In studying inheritance the geneticist often meets with apparently well-defined characters distinguishing two races of animals or plants which represent a multiplicity of factorial differences; and it has been shown increasingly that apparent exceptions to the law of genetic segregation fall into line when the data are fully analysed from this standpoint. It is now necessary to consider briefly what happens when we are dealing with a form that is heterozygous with respect to more than one pair of factors. Two allelomorphic pairs may either segregate independently or altogether. It will be best to describe what occurs when we mate among themselves the progeny of a cross between individuals differing with reference to two pairs of factors.

Experiments with Drosophila.

In the wild form of the fruit-fly Drosophila, the wings are fully developed and the body colour is gray. During the past ten years there have appeared in Professor Morgan's cultures two mutants (sports) differing from the parent stock in having respectively vestigial wings and "ebony" body colour. Both the vestigial condition of the wings and the "ebony" colour are recessive to the wild condition (long wings and gray body); and if an "ebony" mutant is crossed with a vestigial mutant the F1 individuals are like the wild type, gray with long wings. When, however, these F1 forms are interbred, instead of giving a progeny with similar characteristics as would the original wild stock, they throw four types, namely, gray flies with long wings, gray flies with vestigial wings, ebony flies with long wings, and ebony flies with vestigial wings in the proportion 9 : 3 : 3 : 1. This is what would be anticipated if the gray-ebony pair of factors segregate independently of the long-vestigial pair. For, taking first the colouration of the body, the F2 should contain grays and ebonies in the proportion 3 : 1. For every four ebony individuals there should, if segregation is independent, be three long-winged and one vestigial-winged type. Corresponding to these four ebonies the twelve grays should be composed of long and vestigial types in the proportion of 3 : 1 or 9 : 3. Thus the F2 ratio would be 9 : 3 : 3 : 1, as indicated above. On the assumption that the colour and wing factors are distributed as *independent structural units*, the F1 gray flies with long wings will form four types of gametes, one of which contains both recessive, one both dominant, and the other two either one or the other dominant factor together with the recessive factor of the other pair. This gives on fertilisation sixteen combinations, since each one of the four may unite with four different types; of these only one will contain both recessive factors in duplicate.

Now if separate pairs of genes always segregated independently we should be forced to postulate an indefinite number of structural units to provide a material basis for inheritance. And this would be equivalent to abandoning any hope of identifying the apparatus of segregation in the structure of the gametes by methods at present available. But this is not the case, as was first shown by Bateson and Punnet (1906).



An illustration is provided by a cross between the strains of sweet peas known respectively as the "Painted Lady" and the "Duke of Westminster." In the second the dominant purple colour is combined with a hooded standard. In the Painted Lady the red colour of the flower is associated with the dominant "erect" standard. The F1 are of the type known as "Purple Invincibles," having an erect standard and a purple colour. The F2 contains three types, Painted Lady (erect red), Purple Invincible (erect purple), and Duke of Westminster (hooded purple) in the ratio of 1 : 2 : 1.

But no hooded reds appear among the progeny. As a scrutiny of the accompanying diagrammatic representation will sufficiently demonstrate, this result at once receives an explanation, if we postulate that

the factors for the shape of the standard and the colour of the flower, though physiologically distinct, are distributed among the gametes through a common structural unit. The association of genes belonging to distinct allelomorphic pairs in the process of segregation is known as "linkage."

Partial and Complete Linkage.

Linkage may be partial or complete. As an illustration of both types the following example from Morgan's work may now be taken. There are in addition to the "ebony" type mentioned above, two other Drosophila mutants, "black" and "sable," distinguished by the black colour of the body. When a "black" fly with vestigial wings is crossed back to the wild parent stock, the F1 individuals are gray with long wings as in the ebony vestigial cross. Now, if the F1 males are mated with females of the black vestigial type, the entire progeny are either gray with long wings or black with vestigial wings (1 : 1). The same result is obtained in the F1 generation of a black fly with long wings and a normal gray fly with vestigial wings, all the progeny being gray with long wings. But if these F1 males are crossed back to the black vestigial females, the offspring are one half black with long wings and the other half gray with vestigial wings. It is clear in this case that both results are capable of being interpreted as before if we assume that a single pair of structural units is involved in the distribution of both pairs of genes among the gametes.

If now, instead of crossing back the F1 males to the double recessive females, the reciprocal mating of the F1 females to the double recessive male type is made, the result is slightly different. Taking first the case where both the recessive factors (black and vestigial) were brought in from the same parent, it is found that the back cross of the F1 females, instead of giving 50 per cent. vestigial and 50 per cent. gray long, produces 41.5 per cent. gray long, and 41.5 per cent. black vestigial, together with 8.5 per cent. black long and 8.5 per cent. gray vestigial. Similarly, if the F1 females of a cross in which only one recessive factor is introduced by each parent are back-crossed to the double recessive male, the progeny, instead of being 50 per cent. black long and 50 per cent. gray vestigial, are 41.5 per cent. black long and 41.5 per cent. gray vestigial, together with 8.5 per cent. black vestigial and 8.5 per cent. gray long. The numerical results are here amenable to interpretation on the assumption that there exists a single pair of structural units carrying both pairs of factors; but that in 17 per cent. of the cases a crossing over occurs between the two components. It must not be inferred from this illustration that complete linkage is characteristic of the male and partial linkage of the female in general among animals. The foregoing example was selected purely for convenience as exhibiting both types of linkage with respect to the same two pairs of genes. Linkage has been studied very extensively in Drosophila owing to the fact that several hundred mutants from the wild stock have appeared in Professor Morgan's culture during the past twelve years. It is found that in Drosophila, if a factor *a* is linked to a second factor *b* which is again linked to a third factor *c*, *a* is always found to be also linked to *c*. Similarly, if *a* segregates independently of *d*, *b* and *c* which are linked to *a* will likewise segregate independently with respect to *d*. Thus all the mutant factors of Drosophila can be arranged in groups, such that the members of one group show linkage *inter se* and segregate independently with respect to the members of the remaining groups. The number of such groups in Drosophila is four. To interpret Mendelian segregation in Drosophila, therefore, we thus require four pairs of segregating structural units.

We may thus epitomise the inferences that can be drawn from the analysis of experimental breeding by conceiving the material basis of inheritance in terms of discrete units which are :—

(i.) Structurally continuous throughout all the cell divisions of the germ-cycle from fertilisation to the liberation of the gametes ;

(ii.) Present in *duplicate* in the fertilised egg ;

(iii.) Segregating into maternal and paternal components at some point before the ripe gametes are formed ;

(iv.) Present in the germ cells in pairs which correspond numerically with the number of linkage groups.

To-day we are able with the aid of the microscope to identify structures in the germ cells which, as we shall see in the next article, satisfy these conditions of the Mendelian hypothesis.

Bayer 205.

Sleeping sickness, which is caused by a parasite carried by the tsetse fly, has within the last fifty years decimated large areas in Equatorial Africa. Considerable success has attended treatment with a German compound, "Bayer 205," whose formula was kept secret in the interests of their colonial empire. It is now reported that the French firm, Fourneau, has discovered the formula independently, and that the drug will be available for all who require it.

Wild Bird Photography

By G. A. Metcalfe, B.A.

MANY people who would willingly take up the absorbing study of bird-life with the help of the camera are deterred by the fear that its difficulties are almost insurmountable save to the expert. This is really far from being the case. Patience and a sympathetic understanding of bird nature are undoubtedly useful.

YOUNG JACKDAWS ON CHIMNEY POT.

But if the simple precautions suggested in this article are followed, there is nothing to prevent a beginner from quickly obtaining a series of photos of some, at any rate, of our English birds at their nesting season.

The first essential is a good plate camera, which allows of accurate focussing on a ground-glass screen. The size of the plate does not really matter, but quarter plate, or 5 × 4 are the most convenient. The speed of the plate should be upward of 300 H. & D., so that the shortest possible exposure consistent with a good negative is obtained. The lens should be of fairly long focal length, and should of course cover the whole plate. The aperture of the lens should be large, if possible f4.5; but a great deal can be done with much smaller and less expensive lenses, and most of my own work of birds on the nest is done with an aperture of f7.7, often stopped down to f16 or f32. A telephoto lens is a most useful accessory, but has the disadvantage of being very expensive. The shutter should be silent and for ordinary work the "between lens" shutter is good enough. For higher speed work the focal plane shutter is the best, but the ordinary focal plane shutter is noisy, and a special one should be obtained.

Two stands should be obtained; one for high ground work, and one for low. The ordinary metal telescope stand is useful for low work, but a stronger wooden stand with long extension should be used for high. On the top of the stand, between it and the camera, a strong universal joint should be interposed. This is a most essential piece of apparatus and saves a tremendous amount of difficulty and time.

Choose the Breeding Season.

I may now go on to describe a few of the methods I have found useful in obtaining the photograph. The breeding season is without doubt the best time to start. It is then that birds of all descriptions and species will disregard strange objects and noises in their vicinity, which at ordinary times would cause the utmost wariness and caution. It is then that the parent bird will brave any danger to care for its young; and it is then that the photographer has his great opportunity.

The nesting site is the centre of operations. There are three chief ways of obtaining the photograph; the first, and best, is that in which the photographer is hidden with his camera within photographic range of the nest. The second, which sometimes has to be employed, is that in which the camera is hidden near the nest, and the photographer remains at a distance, releasing the shutter by bulb and long tubing, or by electric or other means. The third is by telephoto lens.

The first of these is by far the most interesting and exciting, as the photographer has a close view of the bird and can watch its habits, and choose the moment at which it is in the most favourable and picturesque position. Several photographs can then be taken without unduly disturbing incubation, and by far the most satisfactory results obtained. Telephotographic methods also are very satisfactory, but one feels that one is taking an unfair advantage of the bird in obtaining them. The second method is useful where time cannot be afforded in making a large tent close to the nest, or where the nest is amongst thin and fragile branches, or the bird of timid disposition.

Birds nesting on the ground are the best to commence with. It may be thought that the common garden birds should be the easiest to get, owing to their familiarity with strange human objects; but I think the beginner will find that this is not so, and that birds seemingly much wilder and more shy of human approach will require less ingenuity than their bolder and commoner brethren.

Photographing the Lapwing.

As an example of an easy ground-nesting bird I shall take the lapwing or green plover. This bird

in the spring resorts to moors, ploughed or grass fields, where it scrapes a hollow in the earth, lines it roughly with heather, rushes or grass and deposits therein four beautifully marked pointed eggs, each with its sharp end towards the centre of the nest. While an intruder may be perhaps two hundred yards away the bird slips off her nest, runs along the ground for twenty or thirty yards before rising, and then wheels about overhead uttering her plaintive "pee-wit." As the intruder gets nearer the nest the bird's cries get more and more agitated and she swoops and dives in a frantic manner, endeavouring to drive him away.

You must first find the nest, being careful not to step on, or too near it, and also being careful not to handle the eggs. Pretend you haven't seen it, but mark it with a stake driven in a few yards from it. Go right away and make your preparations for building a cache. A very useful tent can be made as follows: Obtain four stout stakes about 3½ feet long to drive into the ground. Get two good sacks, preferably not too new, open them up by slitting one side and the bottom and sew them together with their longer sides approximated, so that a sheet of canvas about 6 ft. × 8 ft. is made. This is to serve as a cover for both yourself and your camera. Through what will be the "front" of the tent make a hole in the canvas to fit the lens, button-hole stitch it so that stray strands of sacking won't fall across the field of vision. Make two more smaller peepholes on either side so that a view can be obtained from the tent. To the outer side of this cover stitch bunches of grass, hay, or heather,—whatever the surrounding country prescribes—making it look as natural as possible. Get a cylindrical glass bottle with an end about the size of your camera lens, and set out with all your apparatus.

Send an assistant, preferably a country lad, into the field before you to raise the bird; then as expeditiously as possible erect your tent. In doing so be careful not to disturb the nest. Drive in the stakes so that the front ones are about four or five feet from the nest, and about three feet apart. The back stakes should be placed about 4½ or 5 ft. from the front ones, making a quadrilateral of about 3 ft. by 5 ft. in size. In pegging out this space the best point of view of the nest must be borne in mind and the sun's direction not forgotten. Cover the stakes with the canvas so that the hole is pointing towards the nest. Tuck the edges in and peg them down so that the canvas does not blow away. Throw some loose hay or heather over the exposed parts, put the bottle in the hole so that its end just projects, and leave everything.

Setting up the Camera.

Next day come with your camera and if possible two assistants. Send your country lad into the field before you, and, when the bird has been chased off, set up your camera. Do not make the mistake of erecting it too high, with the object of obtaining an undisturbed view of the nest; but keep it as low as possible, so that when a few intervening rushes have been removed a view of the upper half of the eggs are visible on the screen. Make sure that the lens has an undisturbed view through the hole you have made, and, if necessary, tie the edges of the hole round the lens, so that if it blows the canvas will remain undisturbed. Focus up very carefully on the nearer side of the eggs, and stop down till a band embracing both sides of the nest for a little distance is in focus. Get your assistant carefully to remove obtrusive objects and make sure the lens is clear. Close your shutter, adjust the time, put

LAPWING ON NEST.

in your plate and pull out the slide. Get your assistant to make sure that you are entirely covered. Send both your assistants clear away, and tell them not to return. Then wait without a movement. In five minutes or so you may see the bird land on the ground perhaps 50 yards away. You will see her run back and forwards in front of you, gradually coming nearer and nearer, always keeping her eye on your tent. She may run behind and all round you, but so long as you remain perfectly still she will be on the nest within a quarter of an hour. Now is the moment

of great excitement. Unless you are prepared for a very quick exposure do not press the bulb. Gently click the side of the camera stand with your finger nail: in a flash the bird will be gone. Do not be disappointed; she will be back in five minutes. Again do the same; again she will go Do it a third time: she will then only start, perhaps get off the nest and come back again. When she is settled you will probably be able to click the stand as much as

MISTLE THRUSH ALERT.
(Taken by box method).

you like without disturbing her. Now you can safely expose your plate. The difficulty will be from this point on to get her to move off the nest in order to get a different view, but this can usually be done by showing some slight movement. When she is gone change your plate, adjust your exposure and direction for whatever position you may wish to get her in, and wait. I actually found that by these manœuvres I could get out at the back of the tent, crawl away hidden by it, and eventually get right out of sight without disturbing the bird!

The Common Snipe.

I have taken the Lapwing as an example of a bird easy to take. The Common Snipe may be taken as an example of a rather more difficult study. Here the main essentials are very much the same, but more care and caution has to be exercised in preparing the way. The Snipe nests in very similar localities to the lapwing. It, however, selects ground in which longer rushes grow, and makes its nest in the centre of a small clump, so that the whole nest is practically invisible to the passing eye. The bird sits very close, and one has almost to tramp on the nest before she rises. The main difficulty is the ease with which you can cause the bird to forsake her nest, and I have found a useful way to prevent this is as follows:— Find the nest by flushing the bird; mark it with a stake as before, and leave without touching it. Next day get your assistant to bring along a large pitchfork of hay, and, without disturbing the bird, to deposit it where your stake is inserted. Do not go near the spot for two days. Then come with your tent, erect it and cover it entirely with hay, leaving the bottle sticking out as before. Pluck away intervening rushes but do not touch those immediately surrounding the nest. Leave for a day, and then come prepared for photography. Separate the rushes round the nest to give a good view, pull out a few if necessary, and set up your camera as before. You will find that within half an hour the bird will be on the nest. There will be no need to make preliminary noises, as the bird won't move when you expose your plate, and you can usually give whatever exposure you like.

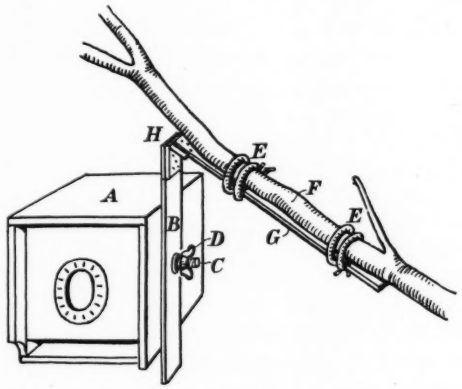
You see that everything depends on your preparations beforehand. It is the same in every case, but the amount of time spent in educating the bird depends on the species, and this can only be learned by experience. It is always well to err on the safe side. Many small birds will stand a great deal more than large birds, and the sedge and reed warblers offer an admirable opportunity for easy work. Here all that is necessary is to sling your canvas bag between the osiers or undergrowth around, throw a few nettles over it and leave it for the night. Next day you can photograph to your heart's content.

Photographing Nests in Trees.

Birds building in trees or cliffs cause more difficulty than those on the ground, and it is here that the telephoto lens gives such invaluable aid. The nest and its surroundings must be carefully studied and the best point of vantage, both for view and suitability of tent erection, decided upon. Measurements for the tent sides should be made, and ways and means for seating and camera position devised. The tent erection must be done gradually and in pieces, only a small bit of canvas covered with appropriate foliage erected at first, and several days interval left between each addition. The bird should always be chased off by the assistant, who should remain very obviously in a field near by, to occupy the bird's attention. If

future photos from the same view-point are wanted the bird must always be chased off by the assistant, so that the integrity of the tent is unquestioned in the bird's mind.

The method of hiding the camera in a box or cover, and releasing the shutter from a distance, may be the only method of getting certain photographs. This method is very useful where it is impossible to construct your tent either for reasons of time economy, lack of material or lack of good position. The box ought to be made to hold the camera, allowing for all the extension necessary, and should have means of attachment to any kind of object. The following arrangement I have found very useful (see figure).



A CONVENIENT ARRANGEMENT FOR BIRDS NESTING ON TREES.

A represents the box holding the camera.

B and G are two pieces of wood hinged together at H ; B is fastened to A by a wing-nut working on a bolt C, driven through the side of A.

G is fastened to a branch F by straps at E, and B can be held vertical by a prop fixed between the ends of B and G.

A can be tilted to any angle required by swivelling it round C and tightening D at the proper position.

In placing the box in position caution must be used, the box being erected first at a distance and gradually moved closer with intervals of time between each movement. Some birds will stand more than others, but the box ought always to be covered with appropriate camouflage. Time is saved in the long run by "making haste slowly." If you are using a cache close by you must take all the precautions I have already described in getting into it.

The photography of young birds is always interesting and gives very pleasing results. The ideal thing to do of course is to get them at all stages from the egg to the time of flight, but this means spending weeks at the same nest, and cannot always be done. You must choose a stage in their career at which they are well fledged but have not yet learned to fly. Those in open nests can be taken on or at the edge of the nest, but others, such as these young jackdaws, have to be taken out and arranged on the chimney-pot, twig, or other object to give a good picture of their quaintness and beauty. The young of woodcock, snipe, plover, duck, waterhen, etc., who leave the nest early, have to be found as they hide in the wilderness, and snapped before they vanish, but by observation of feeding grounds, and careful study of methods of hiding, both young and mother-bird can be found and taken together as a family group.

The Origin and the Development of the Turks

By Margaret M. Hardie (Mrs. Hasluck).

IT is on the borders of China that the Turks first appear, and that as early as 1400 B.C., when Chinese chroniclers complain of raids made into Chinese territory by neighbouring tribes of Turkish nomads. These nomads, the chroniclers inform us, were completely barbarous. They had no fixed habitations such as towns or villages, but moved from camp to camp on horseback, seeking pasture for the horses, cattle, sheep, and camels which formed their sole property. Of agriculture they knew nothing, but lived on flesh and milk ; their dress was the skins of animals. They married several wives, they despised and neglected their old people, probably because old people are burdensome to nomads who, like these Turks, have no wheeled transport. Finally, writing was entirely unknown to them and their Chinese name was Hiung-nu or Hsiung-nu.

For two thousand years more their history is a monotonous tale of harrying the Chinese. In 545 A.D., however, they began to turn their faces westwards. In that year a section of them called Tu-Kuie (that is, Turks—pronouncing *r* was never a strong point with the Chinese !) broke loose from their suzerains in China and moved west towards the River Oxus.

Contact with China had civilised them, for Chinese records note a general improvement in their manners, though they still drank too much *koumiss*. Most noteworthy of all, they had borrowed from Syria an alphabet with letters rather like runes, as we can see for ourselves from the funereal inscriptions discovered in the Yenisei valley and in Mongolia.

These inscriptions usefully supplement from the Turks themselves the information given us by the

Chinese chroniclers. There are still—it is the eighth century A.D.—no cities mentioned, but the tribes seem better organised. Their *khan*, as they call the chief, is responsible for the well-being of his people, while in war, the national occupation, he is expected to fight in person. It is delightful to find carefully recorded the names of the horses he rode in battle.

In religion they are under Chinese influence. The sky-god Tangri is their chief divinity and is worshipped with burnt sacrifices. Ancestor worship is general. Spirits of earth and water are much feared.

FIG 1.—MEN OF KONIA.

Nearly all this is true of Turkey to-day because the Turk is very conservative. There are actually many tribes in Asia Minor and a few in Europe, who are still nomad; Yuruks they are called. The sultan no longer takes the field with his army but he has only lately ceased to do so. Polygamy is permitted. The Scandinavians have forgotten Thor but the Turks still remember Tangri, though now his name has become a mere synonym for *Allah*, God. The memory of ancestor worship survives at the humble tombs of many buried saints, who, their names forgotten, are called *dede*, that is, *grandfather*. The rags hung on trees or left at wayside fountains recall their ancient worship of nature. Only the excessive drunkenness of the primitive Turk has disappeared; the cause was a momentous change which took place in Central Asia in the early eighth century.

The Arab Conquest.

This was the Arab conquest of the Turk's home, Transoxiana. As a result, the Turks, ever borrowers rather than originators, gradually adopted the religion, alphabet, and culture of their conquerors. Prayer to Allah in mosques replaced the old burnt sacrifices to Tangri, their women were veiled for the first time, strong drink vanished. With the characteristic impracticability of their race, they discarded their old runic writing for Arabic, although with Arabic lettering, which does not fit Turkish sounds, it is difficult to write Turkish intelligibly or to read it when written.

It is in this Arabic guise that we next hear of the Turks. That is three centuries afterwards, when the princely family of the Seljuk Turks imposed its authority on the motley tribes of Transoxiana and led them to conquest east, west, north, and south. By 1090 their *shah* ruled from China to the Dardanelles. At his death, however, a few years later, his empire broke up; the western portion separated from the eastern and became the nucleus of the Turkish empire as we know, and knew, it.

Confusion reigned in this western Seljuk empire for a century. Other Turkish princelings, who had invaded Asia Minor, were unwilling to accept the Seljuk *shah's* suzerainty; as may be imagined, when Turk meets Turk, a very pretty fight ensues. Then Greeks, Armenians, and Crusaders all contested the Seljuk advance, but Turks from the Seljuks down to Abdul Hamid and Izmet Pasha have been clever at pitting one nation against another, so the Seljuks made friends with the Greeks and thus beat off their other enemies. By 1150 the reigning *shah*, or *sultan*, as he was now called, was able to establish himself firmly at Konia (Iconium), which therefore became the first capital of the Turks.

Consolidation of their empire was their next concern. Wise viziers ably seconded the sultans as so often in later Turkish history. Positions with high-sounding titles were created at court for Turkish chieftains who, if not skilfully handled, might have given trouble. Moslems were conciliated by the support which the sultans gave the caliph of Bagdad, at that time the religious head of Islam, and by their general championship of orthodox Mahommedanism against certain schismatics who threatened its ruin. Christian traders were privileged (there never was a Turk who liked trading), Christian soldiers were appreciated and favoured in the army, Christian princes were left in possession of their lands and their religion, if they agreed to pay tribute and fight when required. Fanaticism against Christians was as yet unknown.

The government was as cultured as it was statesmanlike. Learning and the arts were encouraged. Poets and wise men were attracted from abroad. Konia and other towns were embellished with beautiful buildings—mosques, palaces, fountains—in the Saracenic style; everything had of course an Arabic or a Persian tincture. The empire was a model.

We know how these Seljuk Turks looked, thanks to Sultan Bayezid "the Lightning." Having conquered Macedonia a little before 1400, he found it inconvenient to garrison so large a new province with troops. He therefore ordered thousands of agricultural Turks to be transplanted from Konia and settled in Macedonia to police it, as it were, against possible disturbances by the native Christians. Memories of their migration from Central Asia were still fresh in their minds, so it seemed small hardship to uproot poor peasants in this brutal wholesale fashion.

The Oldest Type of Turk.

These "men of Konia," as their Christian neighbours call them, are still in Macedonia and still distinguishable from the surrounding populations because they do not intermarry with them. Studying them, we are therefore able to say what the purest and oldest type of Turk looked like. The description is not flattering, he is not good-looking. His nose is straight but short and broad, his mouth is wide, his lips are often thick, his chin is round and weak. His eyes, however, are kindly enough, they are often blue, and his red fez and bright waistband make pleasant patches of colour. He is also tall, averaging five feet eight, and he is powerfully built; his muscles are kept in splendid condition by the hard manual toil which is his daily portion and by the strenuous games to which he devotes his spare time. The *pehlivans*, or wrestlers, of Turkey are world-famous and more than one was seen in England in the happy days before the war.

Our Turk, however, obscures his good points by his dress and demeanour. Round his fez he winds, like his nomad ancestors, a long, turban-like scarf, which is perpetually untidy and gives him an unprepossessing, dilapidated look. His baggy, ill-cut clothes, his heavy, vacant expression, and his slouching gait are also wilful faults which a little care might cure.

The women scarcely ever look young and surprisingly few are pretty. Their headdress, moreover, would rob the prettiest woman of all pretension to beauty. One sombre kerchief covers the hair, as the Mahommedan religion requires, while a second swathes the chin as if the wearer were suffering from mumps. Anything more unbecoming was never devised. They are square and strong in build, however, and unhampered like their Christian sisters in the Balkans by early marriage and early motherhood, they grow to five feet three or four in height. They are fit mothers of a virile warrior race.

In other respects Turkish parentage has always been an excellent foundation for the military life. From their earliest days their family system has been patriarchal, grown up sons continuing to live with their parents. For such a life to be possible discipline must be strict. So until his death the father's word is law and afterwards the eldest brother's word is law. From babyhood the younger brother has yielded the elder unquestioning obedience, the elder has shown no conceit or hectoring of the younger. Officers find little disobedience among soldiers so disciplined at home.

Unfortunately, a warrior people cannot keep the peace and the Seljuks conquered once too often, when in 1230 they defeated the prince of Erzingan. For

FIG. 2.—A GLIMPSE INTO A TURKISH FARMYARD.

years the Mongols, distant cousins of the Turks, had been threatening Asia Minor, but Erzingan had blocked the way. Now the Seljuks by their unlucky victory had cast the barrier down and were rewarded by the speedy ruin of their empire.

The Mongols, however, could only conquer, they could not consolidate. So Asia Minor, like their

other conquests, continued in a ferment. This gave its opportunity to another Turkish tribe, the Osmanlis.

That is, they were not yet the Osmanlis. They were rather a miscellaneous collection of tribes, who left Central Asia in 1227 and with some difficulty obtained land from the Seljuks. Unlike other vassal chiefs, their leaders were loyal to their liege-lord, abstaining from rebellion and assisting him against

FIG. 3.—A GREEK-SPEAKING MOSLEM OF MACEDONIA AT HOME.

his enemies. In return, the Seljuks generously increased their holdings of land. Soon a chief called Osman so distinguished himself that his name was bestowed on the whole agglomeration of these tribes. The Osmanlis, *Osman's men,* as the Turkish means, were launched on their career of conquest.

The Triumph of the Osmanlis.

They built up their power with great sagacity. When the Seljuk empire finally crumbled away, they did not join in the scramble for the pieces, which would have meant endless fighting with other Turks, as good soldiers as themselves. Instead, they postponed reckoning with these troublesome kinsmen until they should be stronger and for the present turned their attention to the north, where they had only the corrupt Byzantine Greeks to deal with. Their common sense had its reward. Victory followed victory; in 1326 Brusa fell and replaced Konia as their capital, in 1355 they crossed the Dardanelles to attack the Greeks in Europe, in 1453 they took Constantinople, thus confirming their fateful entry into Europe.

They had thoroughly earned their successes by their military skill—even "Timur the Tartar's" attack in 1402 had only shaken, not disabled, them. Their political wisdom was quite as remarkable. Conquered land generally became crown property, so that the sultan had the wherewithal to reward faithful servants, but some was turned into public grazing grounds and some was bestowed in perpetuity on public institutions such as mosques and colleges for their upkeep. Fanaticism against Christians was still unnoticeable. For instance, no considerable massacre soiled the taking of Constantinople, in the treaty which followed large privileges were given the Greeks, the Patriarch was allowed to retain his property and his power. With good reason historians consider the Turks more merciful conquerors than the Latins who had captured Constantinople two centuries before.

This tolerance of the Turks probably explains how they solved a formidable problem which confronted them. It will have been noted that those early nomad invaders of Asia Minor were few in number as compared with the Christians they found in that vast territory. Their constant wars should have reduced their numbers still further. Yet we find that they dominated their subject populations and went on from conquest to conquest, little harassed by rebellions among their Christian subjects. Somehow the original Turks must have replenished their ranks and found means to hold down the Christians.

It is natural to suppose that, to replenish their ranks, they tried to attract fresh Turkish emigrants from Central Asia, but the surly reception at first given the Osmanlis by the Seljuks suggests that this was unnecessary. The fact that to-day the bulk of the population of Asia Minor is Moslem suggests why it was unnecessary. Obviously many native Christians turned Moslem.

There is no need to suppose that they were *forced* to renegade. Contemporary Greek historians make no mention of wholesale compulsory conversions, though they could scarcely have passed them over in silence, had they occurred on a large scale. No, the Christianity of these natives was not of very long standing and they found it to their interest to adopt the religion of their Turkish lords and masters. Doubters may read the old-world *Historia della Casa Musachia* in Hopf's *Chroniques Gréco-Romanes,* which shows in detail what happened at the Turkish conquest of Albania.

Interesting confirmation of this suggestion is found in the physiognomy of some of the inhabitants of Asia Minor. The type is tall, lean, and swarthy, with a long, thin, high nose and an intelligent face. It occurs among so-called Turks, so-called Greeks, and so-called Armenians. More curious still, it is the usual type found on the ancient monuments of the

Hittites. Scholars therefore generally agree that it existed in Asia Minor before ever Greek or Turk came there, and they consider it to have been successively pagan, Christian, and Moslem in religion, as it has been variously Hittite, Greek, Armenian, and Turk in nationality. It is highly suggestive that many Asia Minor "Turks" with these physical characteristics are Kizilbash, that is, nonconformist Moslems whose Islam is frequently reminiscent of Christianity.

With the capture of Constantinople the Turks were firmly settled in Europe, but they continued to extend their empire. In the east constant wars with the Mameluks of Egypt ended in the defeat of that power, the conquest of Syria and Egypt, and the consequent proclamation by Selim I in 1517 of himself as Caliph of all the Moslems, the Caliph of the time being under Egyptian protection. In the west, Greece, Albania, Bosnia, and Serbia fell in rapid succession to their arms, numbers of the conquered embracing Islam while preserving their own language and customs. In this connection I may be permitted perhaps to refer to the February issue of the *Contemporary Review* with its study of the survivals from Christianity which I found among the Greek-speaking Moslems of south-west Macedonia.

The Albanians and the Janissaries.

The conquest of Albania had interesting results for Turkish history. Albania is a barren and mountainous country where life is one long struggle with nature for sustenance. Their natural hardships have from time immemorial sharpened Albanian wits, developed their resourcefulness, and driven them to emigrate. After the Turkish conquest of their country Turkey offered them good prospects. If poor, they found confidential posts requiring intelligence and loyalty; if noble, they entered the army or the diplomatic and government services. Always their intelligence and resourcefulness brought them to the front, so that many of the most famous names in Turkish annals are Albanian. The wonderful Keuprulu family and Mahommed Ali, founder of the present dynasty in Egypt, are especially to be cited.

For a little while still Turkish arms prospered. Bagdad was finally subdued by Murad IV, Crete was conquered by Mahommed IV. But their intermittent wars with Poland had not been uniformly successful and in 1687 their failure before Vienna dealt a crushing blow to their prestige. From this time onwards their history is merely the record of the gradual loss of their various provinces, culminating in what we ourselves have seen, namely, their almost complete withdrawal from Europe and their total evacuation of Africa, Syria, and Mesopotamia.

The beginning of the end was the formation of the famous corps of the Janissaries. Their origin is obscure but possibly the Turks found the old Asia Minor method of voluntary recruiting among their conquered and converted subjects no longer sufficient to feed their armies with the necessary man-power, possibly the Osmanlis were less wise as they were certainly less cultured than the Seljuks. Whatever the reason, soon after the capture of Constantinople it became customary to take Christian boy children from their parents and bring them up in Turkish schools for future service in the Turkish army. Inevitably boys so reared grew up Turks in speech, in religion, and in customs, although they had not a drop of Turkish blood in their veins, so that at first sight the system seems excellently designed to hasten the conversion to Islam of the sultan's Christian subjects. Unfortunately, their military prowess put considerable power into the hands of these Janissaries and they began to dabble in politics and abuse their power. Converts, they had all the proverbial zeal of converts and felt a fanatical passion for Islam which far outran anything genuine Turks had ever felt. For the first time in Turkish history the Christians of Turkey were cruelly oppressed. Now oppression by an alien religion begets religious bigotry and a burning hatred of the dominant Turk arose among the Christians. Then Rousseau's preachings and the French Revolution's doctrines of liberty came to stir the world into consciousness of nationality, which is always in the Levant closely bound up with religion. Her Christian subjects hated Turkey worse than ever. Russia, with her scheming mind already set on Constantinople, fished industriously in the troubled waters. The Christians of Turkey rebelled right and left. The Turks crushed the rebellions. The Christians rebelled again. Turkey offered reforms. Still the Christians rebelled. Turkey's religious and national pride, both hers to excess, were touched to the quick, in a passion of hate she stamped out the rebellions with exceeding brutality, the period of wholesale massacres of Christians began.

I believe that Turkey is as right in her theories as she is brutal in her practice. For the Levant variety of "nationality" fever there is no cure except elimination of the ruler or the ruled. Turkey is human enough to prefer the latter alternative. For a century therefore she followed the hideous path of massacre. Mustafa Kemal Pasha, himself a "man of Konia" from Macedonia, has reverted to the ancient Turkish practice and chosen the still harsh but infinitely

more humane course of expelling from Turkish dominions actually or potentially rebellious subjects. And now Asia Minor is clear of Christians and the world awaits the result. Is Turkey, as her detractors say, incapable of achieving more than military successes? Or are her friends right who point to the present miseries of the Christian minorities in the lately constituted Balkan Christian states as evidence that Turkey was formerly much misrepresented to Europe and that her best efforts at a statesmanlike policy towards her Christian subjects were wilfully frustrated by the Christians themselves, aided and abetted by Russia? Time alone can tell.

Book Reviews

From Immigrant to Inventor. By MICHAEL PUPIN. (Charles Scribner's Sons).

Autobiographies are not usually illuminating reading. The personality of the writer obtrudes itself to an extent that the man as he appears to others is forgotten in the amalgam of egotism and self consciousness that is presented by his pen. Michael Pupin avoids this danger, for in his strangely varied life he had acquired a wide experience of men, a broad range of knowledge and a due sense of the factors that made him what he is. "Many an inventor and scientist has been ruined by being persuaded that he is a 'wizard.'" I have always believed that when a successful inventor is exposed to dangers of that kind he should, somewhat like that king of antiquity, hire somebody to whisper as often as possible into his ear: "You are an ordinary mortal." He is an ordinary mortal in his weaknesses and in his attitude towards many of the problems that have crossed his path and when he seems to himself to be most ordinary he gives unconsciously the impression of being a man with the gleam of genius that places the pioneers in a class by themselves and makes those familiar with their deeds see how genius is able to take note of the commonplace and transform it into the useful and unusual. Born in humble circumstances on the Roumanian border—a Serb with a strong sense of nationality—he attracted the notice of all who came into contact with him. Like Clerk Maxwell he was obsessed with the questioning spirit "What's the why of this" and "What's the particular why of this" and he stored up in his memory incident after incident that became the basis of his inventions. From his boy assistance to the herdsmen who protected the Serbian cattle from Roumanian raiders he learned that sound passed more readily through the ground than through the air and turned this to good account in later life. He had his eyes and his ears open for every opportunity of making progress and his flight to the United States and his hard apprenticeship before he found his feet fitted him for the strenuous scientific work he accomplished. He learned to love the classics and the horizon of his mind and his resilience to new ideas were largely due to the breadth of culture he attained as a classical student. He was weak in mathematics although strong in physical science and in Cambridge under Routh he bore the irksomeness of a training that jarred on him and equipped him for the mathematical calculations that served him well in his inventive career. He made mistakes, as most men do, and his superior mindedness that led him to consider J. J. Thompson of little account because he was so young when appointed as successor to Rayleigh, probably kept him from making discoveries earlier than he did. A volume of La Grange "*Mechanique Analytique*" picked up in a second-hand book shop was eagerly studied and laid aside for ten years. "Travelling through the Furka pass it occurred to me that since the motion of electricity through a wire experiences reacting forces similar to those of in the motion of the material elements in a stretched string, my generalised solution should be applicable to the motion of electricity, and I was immediately aware that I had made a very important invention." He hurried to his laboratory in America and worked out the problems associated with his name in long distance telephony in connexion with high inductance wave conductors. The financial results of his discovery were as great as their practical utility. One in a position to know said "If during the past twenty-two years his company had been compelled to extend its network of conductors so as to give, without employing my invention, the same service which it is giving to-day, it would have had to spend at least one hundred million dollars more than it has actually expended." Those hundred million dollars are in the pockets of the American public and therefore Pupin rightly considers himself a public benefactor.

One of the main merits of this book is the extraordinary lucidity with which the author explains complicated physical problems. Even an untechnical reader can follow his account of the electrical theory of matter, the ideas that lie behind the Rontgen rays and the many other subjects that are treated. He has the rare gift of not only visualising facts but of being able to interpret them to others and it is not too much to say that the volume may be described as a general introduction to modern electrical problems. It is something more than this, for we have a picture of the different methods in which Americans, Englishmen and Germans approach the study of the high scientific problems. Mr. Pupin is a man who believes in steady hard work on the theoretical side and is an advocate of the study of science for its own sake without any regard for the utilitarian fruits of the work. The latter will come, for he holds that any glimpse of eternal truth has a bearing upon life and the search and love of truth will in the long run reward the student. He is the outstanding instance of a man who has made good in the face of obstacles that would have quenched the ardour of the vast majority of men. He is intensely human and has a mystical turn that is characteristic of his Slav ancestry. Whatever may be thought of his efforts to identify his own convictions with those of his mother, who if not idealised must have been as remarkable a personality as her son, no one can lay down the book without realising that here is a man who has won his place in the Temple of scientific pioneers by utilising to the fullest extent imagination, experiment, hard work and pertinacity in following trails that many had missed and more would have missed had not his manysided mind been brought to bear on the task of tracking them to their secret places. Few will fail to understand better modern electrical science and even Einstein's theory after the study of this fascinating record of human triumph over extraordinary difficulties.

Life: An Introduction to the Study of Biology. By SIR A. E. SHIPLEY, G.B.E., F.R.S., Master of Christ's College, Cambridge. (Cambridge University Press, 6*s*.).

Readers of DISCOVERY need no introduction to Sir Arthur Shipley, even if they have not had the good fortune to encounter

others of his delightful works on Natural History and Biology. There is no branch of science more "readable" than Biology, and Sir Arthur Shipley is surely one of the most readable of Biologists.

It is not easy to give an adequate impression of the peculiar character of this most welcome innovation among text-books of biology. It covers, in about two hundred pages, the whole scheme of living things, without a single important omission. It gives at least a reference to the most modern of discoveries and theories. And yet there is such a wealth of literary and historical allusion, such a richness of wit and wisdom, that every page and every topic is enlivened; there is not a yawn in one of the thirteen chapters.

Perhaps an example from the chapter on "Movement" will show the manner of this book.

"The muscles of the wings of insects contract far more rapidly than any other muscles known among all animals. It is held by a good many authorities that the buzzing of the mosquito is due to its wings, and certain experiments have been made upon the note emitted by both sexes. It was found that the males gave a higher pitched note than the females, and that the note was higher in both sexes when they had been fed; the greater the meal the higher the note. This I have also noticed at 'bump suppers' and City dinners. Of four unfed females three gave notes within a quarter of a tone of 264 (i.e., of 240 to 270 vibrations per second), the fourth female gave an abnormally low note of about 175 vibrations. Four other females were arranged in the order of the distension of the abdomen by food, the last being largely distented; these gave notes corresponding roughly to 264, 281, 297, 317 vibrations . . . Three unfed males gave exactly the same note, viz., corresponding to 880 vibrations. Immediately after feeding one gave the note A sharp, another which had fed well B flat."

The illustrations are numerous, and very well chosen. "Life" should stimulate a keen interest in practical Biology in all its readers, and we venture to prophesy that among that number will be many who no longer have to temper their enjoyment of books by the grisly prospect of having to remember for future repetition what they read with a light heart.

Sanderson of Oundle: The Story of a Great Schoolmaster. Being a plain account of the life and ideas of Sanderson of Oundle. By H. G. WELLS. (Chatto and Windus, 4*s.* 6*d.*).

Mr. Wells would find it hard to be dull when writing of one of the few men who have captured his enthusiasm. We cannot, however, think that the readers of this volume will grasp the real greatness of Sanderson who transformed a decaying school into one of the most influential educational centres in the Kingdom. Mr. Wells is apparently so impressed with the errors that have been made by the successor of his hero that his book wears the appearance of being a *tour de force* to show that unless Sanderson be repeated, Oundle must cease to be what it was. But no reader can fail to see that Sanderson could hardly have left a successor who would follow his plans in their entirety, and we at times think that Sanderson—had he lived—would have failed to have won the whole-hearted approval of Mr. Wells. Part of Sanderson made a powerful appeal to his biographer—part of him failed to grip his whole heart, and yet the work done was done because Sanderson was the man he was. Make him all in all, and we see the reasons for his great success. Dissect him or rather remodel him on the Wells ideal, and he would not have succeeded to the same extent. In spite of this drawback the biography gives a picture of a man who believed that school should be the training ground of citizens who start life with the sense of service and the conviction that only by the putting in practice ideals boys can achieve anything worth accomplishing. He trained his boys to work together, to test theories for themselves and to develop latent capacities to the fullest extent. He individualised by grouping and he thereby managed to make learning interesting and to build character without boys recognising what he did. With him the spirit was everything, and all who caught his spirit started life well equipped to perform the duties that came their way in life's tumultuous stream. The school was the man and the man made the school because he transferred to the boys his own great enthusiasm and unselfish devotion to duty.

Luxor and its Temples. By A. M. BLACKMAN, D.Litt. and Major Benton Fletcher. (A. and C. Black, 7*s.* 6*d.*).

Dr. Blackman and Major Fletcher are old friends who share interest in Egypt. The former knows the history—the latter has a pencil which is able to reproduce with deft strokes the scenes he loves and the buildings that inspire his imagination. Between them they have given us a volume that will make a wide appeal, for the story of Luxor and its surroundings has made the average reader more familiar with it than he is with many places within a few miles of his residence. In addition to local knowledge, Dr. Blackman is the fortunate possessor of a style that enables him to pass on his thoughts to others and in so doing he gives the impression that he thinks in the past and brings it before us with a vividness that makes us forget we are dealing with far-off events, long before history came to birth in our own island. The modernity of ancient Egypt surprises us. Civilisation then was by no means dissimilar to what we now pride ourselves on possessing. The ancient houses, as described, were as comfortable as those of to-day, and their internal equipment was ordered with a view to efficiency. The illustrations are well selected and the reader can reconstruct the ordinary life of the people without difficulty. Food and drink, occupations and amusements are set before us and it is clear that human nature under the Pharaohs did not differ much from what it now is. Bread and beer were the staple food of the ancient Egyptians of both sexes and all ages, and we regret to say that drunkenness was by no means unknown. Overeating too showed itself, and if the cigarette was not enjoyed at banquets the lotus flower took its place.

Egypt possessed a great Queen—the first woman "who attempted to show that woman can rival man in political life, aye and in some spheres even surpass him." "The Queen and her ministers so devoted themselves to architectural undertakings, exploration, and other peaceful pursuits—forgetting that it is the strong man armed who keeps his house—that by the end of her reign the Egyptians' hold on their Asiatic dominion was in jeopardy." We have, too, the idle boy and the good advice he received—in fact it is not too much to say that Dr. Blackman makes the inhabitants of ancient Luxor and their surroundings almost as familiar to us as if they could be visited by present-day travellers. We hope that the book will have a large sale and that it will lead its possessors to make themselves familiar with the works mentioned in its admirable Bibliography.

Making the Weather. By ALEXANDER MCADIE. (Macmillan).

This small book by a competent authority contains sound sense and the refutation of many popular ideas concerning meteorology. We all are aware of the importance of knowing what the weather may be and are frequently disappointed by the forecasts. Professor McAdie shows us the limitations of weather science and the folly of imagining that man can control

the weather. His illustrations of inability to foresee changing conditions during the Great War are at once arresting and illuminating.

Technical Writing. By T. A. RICKARD. (Chapman and Hall, 10*s.*).

A book from America on the correct writing of our tongue seems to have a wrong place of origin, for most of us have found the average American scientific volume a veritable mine of solecisms. Mr. Rickard was trained in England and probably this has given him affection for the well of English undefiled. At any rate he has brought together a number of practical hints as well as a generous collection of the faults of scientific writers who obscure their thought and spoil their work by indulging in language that is a torture to the reader who wishes to see language correspond with grammatical rules and customary idiom. We go further and say that this admirably compiled and readable volume may be read with advantage not only by scientific workers and business men, but also by "the man in the street," who has to put his thoughts and wishes on paper. With the advancing standard of education the public expects its instructors to know how to write their mother tongue. The Editor of DISCOVERY has had frequently to reject articles through the inability of their writers to express their thoughts in a language understood by its readers.

The Wonders of the Stars. By JOSEPH MCCABE. (London: Watts & Co.).

Mr. Joseph McCabe has long been before the public as a clear and lucid writer on scientific subjects. Those who have read his "ABC of Evolution" will begin this companion work on "The Wonders of the Stars" with pleasurable anticipation; and they will not be disappointed. Mr. McCabe is the master of a clear and crisp style and he certainly makes his subject live. The book is to be heartily recommended to the beginner in astronomy as an admirable popular summary of modern astronomical science.

Here and there, one can detect the fact that the writer is not himself an astronomer, and some of the statements in the book are open to challenge. For instance, on page 7, Mr. McCabe states that "most astronomers now think that the stars are distributed, not in a ring, but in great spiral arms, something like the core of a watch-spring" and that "our universe is not nearly so flat as we used to think." Dr. Shapley's researches indicate a diameter of about 300,000 light-years and a thickness of 6,000. This gives us a flatter universe than did the theories of Newcomb, Gore, Proctor and others. Again on page 99, Mr. McCabe omits all reference to Seeliger as the real author of the "star-and-nebulæ" theory of temporary stars, and almost leaves the impression that he himself originated it. Indeed, Mr. McCabe is too prone to strike the personal note and to obtrude his own materialistic presumptions into what is otherwise a very useful little book.

Eclipses of the Sun. By S. A. MITCHELL, Professor of Astronomy in the University of Virginia. (New York: Columbia University Press. London: Humphrey Milford, Oxford University Press, 17*s.* net).

This massive volume is unfortunate in its title. To all intents and purposes it is a treatise on the Sun, and with slight expansions and additions it could have taken its place beside the standard works of Young and Abbot. The branch of astronomy dealing with solar eclipses is certainly Professor Mitchell's starting-point, but as the work proceeds, such topics as the spectroscope, the surface of the Sun, the flash spectrum, the heights of vapours in the solar atmosphere, atomic theory, ionization, the problem of the corona; and the Einstein theory come under review and are more or less exhaustively dealt with; so that the whole realm of solar astronomy comes within the compass of this book of 419 pages.

Professor Mitchell is himself an authority on solar astronomy, and has observed more than one total solar eclipse. In addition, he has drawn upon many valuable sources of information, so that his book is to be heartily commended as the most reliable and up-to-date summary of the present position of solar science. For in the twelve years which have elapsed since Dr. Abbot's valuable book was published, extraordinary progress has been made in this as in all other branches of astronomy; while Young's classical work is completely out of date and useful chiefly from the historical standpoint.

Professor Mitchell's conclusions regarding the solar atmosphere and the corona are of deep interest. As to the photosphere, he adopts with modifications Young's theory. "By means of convection currents gases from the interior of the Sun are brought to the surface. There set free from the enormous internal pressure and meeting the cooler temperatures of outside space, the gases expand." The photosphere is in a state of continual commotion. The "granules" which have for many years attracted attention "seem to be the summits of a fleecy structure of condensed particles. In fact, they represent on an enormous scale a phenomenon similar in appearance to a storm-tossed and choppy sea when viewed aloft from an aeroplane." The actual solar atmosphere is the chromosphere. "The reversing layer," says Professor Mitchell, "has no existence apart from the chromosphere. It is the densest part of the chromosphere lying closest to the photosphere and it is the cause of the greatest portion of the absorption producing the Fraunhofer lines." The enhanced lines, which are prominent in the chromospheric spectrum, are due to ionization, which in turn is produced by diminished pressure in the upper regions of the chromosphere.

The discussion of the corona could not be improved upon. Professor Mitchell has made a special study of this mysterious appendage. He advances a new theory of its institution which he calls an "electron theory." "The high temperature of 6,000°C with moderate pressures at the photosphere amounting to a small fraction of a terrestrial atmosphere, permits a ready discharge of electrons. The general magnetic field of the Sun aids in this discharge . . . On account of the intense radiation the electrons leave the Sun in vast numbers and with energies that carry them to great distances from the Sun. The electrons quickly reach the corona, a region of very minute densities. When the electrons in their flight outwards from the Sun impinge on atoms their energy is transformed by displacing the outer electrons of these atoms from their positions normally occupied. These external atoms thus become centres of disturbance from which are radiated various forms of energy, which may be manifested as light, electromagnetic and photo-electric effects, phosphorescence, fluoresence, etc."

Even of a volume so useful and exhaustive, some words of criticism must be added. The book would have been improved by the omission of much of the matter of chapters X and XI, relating to the author's personal experiences in Sumatra and Spain. His descriptions of native life in the East Indies and of a Spanish bull-fight are interesting but irrelevant in a work such as this, and the author would have been well advised—if he felt it absolutely necessary to include these experiences—to have dealt with them in an appendix. Special mention should be

made of the excellence of the illustrations, especially of the beautiful frontispiece, from a painting of the total eclipse of June 8, 1918, by H. R. Butler. This magnificent picture greatly enhances the value of an excellent book.

Elementary Aeronautical Science. IVOR B. HART and W. LAIDLER. (Oxford, at the Clarendon Press, 7*s.* 6*d.* net).

It is fortunate that the modern young man shows so keen an interest in aeronautics. For most "grown-ups" flying has lost much of its glamour, and one realises, a little regretfully, that the hum of an aeroplane passing overhead, rouses no more emotion than does a sight of a taxicab. To the schoolboy the aeroplane is not a prosiac object, and although aeronautical science is still outside the school curriculum, one feels that at no distant date natural science will have a formidable rival for the affections of the young. The book under review is a fitting companion to the more familiar school text-books. Here perhaps is a science whose fascination will prevent the student from following his time honoured custom of consulting the answers for guidance to the method of attacking a problem. The authors have, as they say, filled a long felt want, and one can only regret that the volume was not available to those wartime pilots who found "Theory of Flight" so difficult, and so dull. The work teaches the student of limited mathematical skill as much as he can learn of the subject, while the mechanics of the more complicated "aerobatics," such as spinning, are wisely omitted, as being outside the reader's scope.

Books Received

Early Architecture in Western Asia. EDWARD BELL, M.A., F.S.A. (G. Bell & Son, 10*s.*).

The Road Book and Itineraries of Great Britain, 1570-1850. Introduction and Bibliography by SIR HERBERT GEORGE FORDHAM. (Camb. University Press, 7*s.* 6*d.* net).

The Historical Study of New High German. A. KIRK, B.A. (Longmans, Green & Co., 6*s.*).

Anatolian Studies Presented to Sir William Mitchell Ramsay. Edited by W. H. BUCKLER and W. M. CALDER. (Longmans, Green & Co., 35*s.*).

The Deluged Civilization of the Caucasus Isthmus. REGINALD AUBREY FESSENDEN. (J. T. Russell).

Ultimatum. VICTOR MACLURE. (George G. Harrap, 7*s.* 6*d.*).

Modern Theories of the Unconscious. W. L. NORTHRIDGE, M.A., Ph.D. Introduction by PROFESSOR J. LAIRD. (Kegan Paul, 8*s.* 6*d.*).

The Nature of Laughter. J. C. GREGORY. (Kegan Paul, 10*s.* 6*d.*).

The Growth of Civilization. W. J. PERRY, M.A. (Methuen & Co., 6*s.*).

Icarus. BERTRAND RUSSELL. (Kegan Paul, 2*s.* 6*d.*).

The Inversion of Science and a Scheme of Scientific Reformation. FREDERICK SHODDY, M.A., F.R.S. (Hendersons, 66 Charing Cross Road, 6*d.*).

Wireless Telephony: A Simplified Explanation. R. D. BANGAY. (The Wireless Press, 2*s.* 6*d.*).

Up-to-date Gramophone Tips. CAPT. H. T. BARNETT, M.I.E.E. (Published by Author, 1*s.*).

Bibliographie des Déterminants à plus de Deux Dimensions (MAURICE LECAT. (Published by Author.).

International Press Review. (International Press Cutting Bureau, 1*s.*).

The Mantis and his Friends: Bushman Folklore. Collected by the late DR. W. H. I. BLEEK and the late DR. LUCY C. LLOYD. Edited by D. F. BLEEK. (Basil Blackwell, 6*s.*).

Extinct Plants and Problems of Evolution. D. H. SCOTT, M.A., LL.D., D.Sc., Ph.D., F.R.S. (Macmillan & Co.).

British (Terra Nova) Antarctic Expedition, 1910-13.

Physiography.—Vol. V.: Robinson Bay and Terra Nova Bay Regions. R. E. PRIESTLEY, M.C., M.A., Cantab. (Harrison & Son, 7*s.* 6*d.*).

Vol. VI.: The Physiography of the Ross Archipelago. F. DEBENHAM, O.B.E., B.A., B.Sc. (Sidney), M.A., Cantab. (Harrison & Son, 5*s.*).

Physiography of the Beardmore Glacier Region. C. S. WRIGHT, O.B.E., M.C., B.A. (Research Cantab.), M.A. (Toronto), F.R.A.S., F.Inst.P. (Harrison & Son, 5*s.*).

India of To-day.—Vol. IV.: India's Mineral Wealth. J. COGGIN BROWN. (Humphrey Milford 3*s.*).

The Measurement of Disease.

The estimation of the degree of infection from which a patient is suffering is one of the most important parts of a doctor's duty. Diagnosis is a relatively simple matter, involving only the application of a number of familiar rules. But one of the first things that a patient wishes to know is "How ill am I?" And it is precisely with regard to that question that the physician, up to the present, has been most silent. Only many long years of experience have been able to help him to an opinion.

For many years past, however, a method has been in practice in Paris and elsewhere, whereby it has been possible to express in figures the degree of infection. Until recently, it has been applied only to one common disease, but there are indications to-day that it may have a much wider usefulness.

The method depends on the fact that a colloidal solution (for example, dilute gum) when mixed with human blood, from which the red cells have been removed, becomes opaque. The maximum opacity is obtained in healthy blood at a certain dilution of the blood. In the case of patients suffering from many diseases, the conditions under which this increased opacity is obtained are found to vary. The opacity of the colloidal solution is measured by an optical instrument, and can be read on a scale reading from zero to over a hundred. Since the opacity varies with the degree of infection, this figure represents the gravity of the patient's condition. In the same way, moreover, the effect of treatment may be followed. This is of the greatest value in chronic diseases, where, as in Tuberculosis, there are great apparent variations in the condition of a patient from day to day, and the beneficial effect of any line of treatment is not easy to estimate with certainty.

As yet this method, which was introduced in Paris by Dr. Vernes, has not been very widely applied, and it is not yet possible to be certain of its general applicability. But the attempt to obtain an exact estimate of the intensity of infection and degree of existence deserves notice.

Correspondence.

To the Editor of DISCOVERY

SIR,

In the interests of accuracy may I be permitted to make a few remarks with reference to an article on *Gem Gathering in Ceylon* by Mr. T. Bowyer-Bower that appears in your issue for October last ?

Mr. Bowyer-Bower seems to have but a hazy idea of Ceylon geology, and his statement that " the whole of the island may be taken to be of igneous origin " is misleading ; for besides a great development of crystalline rocks which are almost invariably classed as metamorphic in origin, there are, in some parts of the island, extensive areas of Miocene sedimentaries, while in the north-western province Jurassic beds occur. It must be admitted, however, that the latter form but a small proportion of the colony.

Mr. Bowyer-Bower's reason for regarding the gems as having " been *in situ* originally " are peculiar, although there can be no doubt that the main conclusion is correct. Moreover, as far as I am aware, garnetiferous granite does not occur in Ceylon, but garnetiferous gneiss crops out in some districts—near Haputale for example. With regard to the probable sources of origin of the Ceylon gem-stones, Mr. Bowyer-Bower might do worse than consult *Economic Geology, August* 1923, p. 514.

Mr. Bowyer-Bower's theory as to how the gems found their way into the placer deposits is also peculiar, and the supposition of their encasement in " alumina mud " (whatever that may be) is unnecessary.

Economic Geologists would doubtless be interested to know what " Latterite " and " Kaoline " are, were it not obvious what Mr. Bowyer-Bower means ; but before printing scientific terms Mr. Bowyer-Bower should acquaint himself with their usual orthography.

The statement that the stream bed " consists of well-worn granite . . . . " is ambiguous, for it is not clear what Mr. Bowyer-Bower means by the stream bed. If he means the bed-rock I can only say that the statement is generally untrue ; for in practically all the permanent streams (whose beds or whose high level gravels are the main sources of Ceylon gems) the bed-rock is a soft, highly kaolinised, crystalline rock, known to the gemmers by the generic name of *malawa*.

The winnowing of sand from gems in a concentrate is no very difficult matter to a Sinhalese woman used to separating the paddy from the husk ; but the supreme test of skill which Mr. Bowyer-Bower describes is very much easier, as the following approximate average specific gravity figures will show :—sand 2.5, the heavier Ceylon gems 4, thorianite 9. It may further be remarked that, to the best of my knowledge and belief, officers of the Mineral Survey made use of winnowers for separating thorianite from heavy residues (locally known as *nambu*) as long ago as 1904.

Reconstructed rubies and sapphires have not been made for many years. The synthetic stones, to which, presumably, Mr. Bowyer-Bower refers when he speaks of " glass substitutes," are crystalline corundum artificially produced. Their detection depends not on the presence in each of a very minute bubble, for indeed natural stones frequently contain bubbles, or something very like them. It is the shape and arrangement of the bubbles and colour bands that serve to distinguish the artificial from the real gems.

In the separation of diamonds from other minerals use is made not only of specific gravity, but also of the remarkable proclivity of the diamond to adhere to a greasy surface. May I suggest that Mr. Bowyer-Bower adjusted his sluice at a wrong angle, or omitted properly to regulate his water supply, or both ? A perfectly clean separation of gems is not to be expected by such methods, but the result should have been good enough for hand picking.

Dalam (which Mr. Bowyer-Bower spells dallam) is not " imperfect gems and crystals of all kinds " but translucent corundum of too poor a quality for use as gem-stones. *Nambu* is the term which Mr. Bowyer-Bower should have used in the place of " dallam."

The water-tight gem-washing basket (*Wattiya*) is new to me. I should not like to say that a perfectly new *wattiya* is never water-tight, but I have never seen one in use that remained so for long. Not only is no useful purpose served by rendering the basket permanently water-tight, but there is good reason why it should not be so. Indeed the absence of fine " black sand " from the concentrate which the gemmers obtain in their baskets is significant ; nor, be it noted, when the Sinhalese go washing for gold, as they do occasionally—or did in my day—do they use the *wattiya* for the purpose of recovering the precious metal.

Engineers and Geologists will be surprised at Mr. Bowyer-Bower's view that " in all granite formations there is plenty of water."

I agree with Mr. Bowyer-Bower that Ceylon offers a good hunting ground for the mineralogist ; also it must be admitted that gemming as a holiday pastime *might* pay a European, but the odds are that it will not. It may be remarked, too, that more than one European syndicate or company has attempted to make gemming a paying proposition in Ceylon, but for various reasons of local significance, not one, I believe, has met with success.

E. J. WAYLAND.

THE GEOLOGICAL SURVEY OF UGANDA, ENTEBBE.

31st December, 1923.

To the Editor of DISCOVERY

(*Re* the article on Divination, Feb. issue).

DEAR SIR,

Writing about that form of Divination that employs wax, lead, etc., to foretell the future, you mention that you have heard of it as a nursery game in Germany.

You may care to hear what I am able to tell you about this.

I was brought up in Germany (south) with German (Bavarian) friends.

The casting lead on New Year's eve was a great feature. The punch and doughnuts having been consumed on the stroke of twelve, all standing round the table with raised glasses to wish a happy New Year, the servants brought in a large bowl of water, a spirit lamp, a long iron ladle and small bars of lead which were shared out among those present. Our Hungarian semi-gypsy servant made the sign of the cross over the water and then, amid silence, everyone melted his or her bar and, turning the ladle over quickly dropped the molten lead into the water. If pieces separated it was considered a bad sign. Birds with wings extended and plenty of " moss " or " trees " were desired. This finished and the dumps having been " explained " by the said gypsy maid, the more venturesome of the girls would walk thro' the dark rooms to where a looking-glass hung and try to see her " fate " in it, provided the elders permitted, for one such experiment having had very serious consequences, it was not thought desirable. One would " sneak " off unobserved but frequently fail to summon courage to look in the glass.

The dumps were supposed to be kept till Easter, then thrown away or melted up for lead. This was about 1870-78.

BELMONT LODGE, HASTINGS. E. K. M. COURL (Mrs.)

5th January, 1924.

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Mrs.)